APPENDIX NOT INCLUDED

Sampling and Analysis Plan

Remedial Investigation/Feasibility Study
Wilcox Oil Company Superfund Site
Bristow, Creek County, Oklahoma
EPA Identification No. OK0001010917

Response Action Contract 2 Full Service
Contract: EP-W-06-004
Task Order: 0128-RICO-06GG

Prepared for

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29 June 2016

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LIST OF ACRONYMS AND ABBREVIATIONS

95UCL	95% upper confidence limit of the mean
ACM	Asbestos-containing material(s)
AVS	Acid volatile sulfide
bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, and xylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COPC	Contaminant of potential concern
CRDL	Contract-required Detection Limit
CRQL	Contract-required Quantitation Limit
CSM	Conceptual Site Model
DESR	Data Evaluation Summary Report
DPT	Direct-push technology
DQA	Data quality assessment
DQO	Data quality objective
EA	EA Engineering, Science, and Technology, Inc., PBC
E&E	Ecology & Environment, Inc.
EDB	Ethylene dibromide
EDD	Electronic data deliverable
EDR	Environmental Data Resources Inc.
EPA	U.S. Environmental Protection Agency
ERT	Environmental Response Team
ESI	Expanded Site Inspection
FS	Feasibility Study
FSP	Field Sampling Plan
ft	Foot (feet)
GPS	Global Positioning System
HHRA	Human Health Risk Assessment
HRS	Hazard Ranking System
HSA	Hollow-stem auger
HSP	Health and Safety Plan
ICS	Incremental composite sampling
IDW	Investigation-derived waste

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

LCS	Laboratory control sample
LIF	Laser-induced fluorescence
LMS	Lockheed Martin SERAS
LNAPL	Light non-aqueous phase liquid
MCL	Maximum Contaminant Level
MD	Matrix duplicate
MDL	Method detection limit
mg/kg	Milligram(s) per kilogram
MS	Matrix spike
MSD	Matrix spike duplicate
NOAA	National Oceanic and Atmospheric Administration
NORM	Naturally-occurring radioactive materials
NWI	National Wetland Inventory
ODEQ	Oklahoma Department of Environmental Quality
OS	Original sample
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic aromatic hydrocarbon
PARCC	Precision, accuracy, representativeness, completeness, and comparability
PCB	Polychlorinated biphenyl
PCL	Protective Concentration Level
PPE	Probable point of entry
ppm	Part(s) per million
PSG	Passive soil gas
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RAC	Response Action Contract
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RL	Reporting limit
ROD	Record of Decision
ROST	Rapid Optical Scanning Tool
RPD	Relative percent difference
RSL	Regional Screening Level
SAP	Sampling and Analysis Plan

SEM	Simultaneously extracted metals

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

SERAS	Scientific, Engineering, Response and Analytical Services
Site	Wilcox Oil Company Superfund Site
SLERA	Screening Level Ecological Risk Assessment
SOP	Standard operating procedure
SOW	Statement of Work
SQuIRT	Screening Quick Reference Tables
SVOC	Semivolatile organic compound
TAL	Target Analyte List
TCEQ	Texas Commission on Environmental Quality
TCLP	Toxicity characteristic leaching procedure
TDS	Total dissolved solids
TENORM	Technologically-enhanced naturally-occurring radioactive materials
TOM	Task Order Monitor
TPH	Total petroleum hydrocarbons
TRRP	Texas Risk Reduction Program
TSS	Total suspended solids
USGS	U.S. Geological Survey
VOC	Volatile organic compound
Wilcox Oil	Wilcox Oil Company Superfund Site
XRF	X-ray fluorescence

DISTRIBUTION LIST

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1. PROJECT DESCRIPTION AND MANAGEMENT

EA Engineering, Science, and Technology, Inc., PBC (EA) has been authorized by the U.S. Environmental Protection Agency (EPA), under Response Action Contract (RAC) No. EP-W-06-004, Task Order 0128-RICO-06GG, to conduct a Remedial Investigation (RI) at the Wilcox Oil Company Superfund Site (site or Wilcox Oil). EA has prepared this Sampling and Analysis Plan (SAP) in accordance with: (1) specifications provided in the EPA Statement of Work (SOW), dated 13 July 2015 (EPA 2015b); (2) the EPA-approved EA Work Plan, dated 31 August 2015 (EA 2015); and (3) feedback received during multiple technical exchange meetings between November 2015 and June 2016. The project activities will be conducted under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

This SAP specifically addresses the field program associated with Mobilization Event 1 (see Section 1.2.2.1). Data collected during Mobilization Event 1 will form the basis for subsequent data collection efforts (or mobilizations). EA will revise the SAP prior to any subsequent mobilizations.

This SAP is a combination Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP). It details data collection methods, proposed sample locations and frequency, sampling equipment and procedures, and analytical methods required to collect sufficient data to perform a RI for the site. Combining the QAPP and FSP into the SAP allows for a streamlining of the planning process, while ensuring that the data collected are of sufficient quality for the intended use.

Upon implementation, this SAP should be used in conjunction with the site-specific Health and Safety Plan (HSP) (EA 2016), which specifies employee training, protective equipment, personal air monitoring procedures, medical surveillance requirements, standard operating procedures (SOPs), and contingency planning procedures.

This SAP was prepared in accordance with EA's Quality Management Plan (EA 2014) and meets requirements set forth in *EPA Requirements for Quality Assurance Project Plans (QA/R-5)* (EPA 2001a) and *Guidance for Quality Assurance Project Plans (QA/G-5)* (EPA 2002b).

This SAP details the project specific data quality objectives (DQOs) and describes procedures to ensure that the DQOs are met and that the quality of data (represented by precision, accuracy, completeness, comparability, representativeness, and sensitivity) is known and documented. The SAP presents the project description, project organization and responsibilities, and quality assurance (QA) objectives associated with the sampling and analytical services to be provided in support of the RI. Table 1 demonstrates how this SAP complies with elements of a QAPP currently required by EPA guidance (EPA 2001a, 2002b). DQOs were prepared in accordance with *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA 2006a).

The overall QA objectives are as follows:

- Attain quality control (QC) requirements for analyses specified in this SAP
- Obtain data of known quality to support goals set forth for this project.

The EPA Region 6 Task Order Monitor (TOM), Ms. Katrina Higgins-Coltrain, is responsible for the project oversight. The Contracting Office for EPA Region 6 is Mr. Michael Pheeny. The Project Officer for EPA Region 6 is Ms. Rena McClurg. Upon direction, including an approved Work Plan, EA will perform RI tasks in accordance with this SAP. The EA Project Manager, Ms. Teresa McMillan and the Alternate Project Manager, Mr. Luis Vega, are responsible for implementing activities required by this Task Order. Figure 1 presents the proposed project organization for this Task Order.

1.1 SAP ORGANIZATION

This SAP is organized as follows:

- Section 1 includes the project description, document organization, problem definition and site background, a description of the project objectives and associated data quality objectives, the quality assurance objectives, and documentation that will be generated.
- Section 2 addresses data generation and acquisition, including sampling design and methodology for all media being investigated under the SAP, sample processing, handling and disposal of waste generated during the investigation and decontamination of equipment, analytical methods used, quality control, and data management.
- Section 3 incorporated details on assessment and oversight.
- Section 4 describes requirements for data validation and usability assessment.
- Section 5 contains the references cited in this SAP.

The following appendices support the implementation of the SAP:

- Appendix A Conceptual Site Model Technical Memorandum
- Appendix B Screening Criteria and CLP/Private Laboratory Reference Limits
- Appendix C Analytical Method Reference Sheets and Contract Required Quantitation Limits
- Appendix D Field Forms
- Appendix E Sanborn Maps and Historical Aerial Photographs
- Appendix F Vapor Intrusion Sampling Procedures
- Appendix G Standard Operating Procedures.

1.2 PROBLEM DEFINITION AND BACKGROUND

This section describes the following:

- Purpose of the investigation and sampling events
- Site background and description
- Previous site investigations.

1.2.1 Purpose of the Investigation and Sampling Events

The purpose of this investigation is to complete the characterization of Wilcox Oil by delineating and defining the contamination present at the site and determine if there is a risk to human health and the environment from contamination in soil, surface water, sediment, ground water, and through vapor intrusion. For this purpose, media samples will be collected for analysis so that they supplement existing data and support development of the RI. The data collected as part of the RI will support the selection of an approach for site remediation in the Feasibility Study (FS) and Record of Decision (ROD). The goal is to collect the minimum amount of data necessary to result in a well-supported FS and ROD.

1.2.2 Site Background

The Wilcox Oil site is an abandoned and demolished oil refinery and associated tank farm located north of Bristow, Creek County, Oklahoma (Figure 2) (EPA 2013a, 2015b). The approximate geographic coordinates for the site are 35°50'31" North latitude and 96°23'02" West longitude. The site spans approximately 140 to 150 acres.

The site consists of contaminated areas, including surface water bodies, due to releases from the former Lorraine and former Wilcox Refineries (Figure 3) (EPA 2013a, 2015b). Properties where refinery waste is present at the surface are fenced and secured to deter trespassing and potential contact with the waste. These refineries were located in the N ½ of the NW ¼ of S29 T16N R9E and the SW ¼ of the SW ¼ of S20 T16N R9E in Creek County, Oklahoma. Two refinery process facilities and storage tank areas once operated at the two facilities. Historical investigations indicate the presence of contamination from former activities.

A detailed title search in the Creek County Clerk office confirms that the property was used in oil refinery operations from 1915 until November 1963 (EPA 2013a, 2015b). A skimming and cracking plant was constructed in 1929. The main components of the plant consisted of a skimming plant, cracking unit, and re-distillation battery with a vapor recovery system and treatment equipment. The Wilcox Oil Company expanded when it acquired the Lorraine Refinery in 1937, which was located west of the railroad. Oil refining began in 1915 at the Lorraine Refinery. Wilcox sold the property to a private individual in 1963. Most of the equipment and storage tanks were auctioned or salvaged for scrap metal by the new property owners. Wilcox Oil Company no longer operates in Oklahoma. Based on information from the Oklahoma Secretary of States' office, the company merged with Tenneco Oil Company in 1967.

A modern skimming and cracking plant was constructed in 1929 (EPA 2013a, 2015b). The upgraded facility had an operating capacity of 4,000 barrels of crude oil per day. The main components of the system consisted of a skimming plant, cracking unit, and re-distillation battery with a vapor recovery system and continuous treating equipment. The crude oil was brought directly from the field, eliminating storage and handling facilities, but resulting in crude oil with high sediment and water.

Sanborn Fire Insurance Maps can be used to understand historical property usage (EPA 2013a). The Wilcox Oil and Gas Company and Lorraine Refining Company Sanborn Insurance Maps (provided as Appendix E to this SAP) indicate that the properties contained approximately 80 storage tanks of various sizes, a cooling pond, and approximately 10 buildings housing refinery operations. The maps also indicate that crude oil, fuel oil, gas oil, distillate, kerosene, naphtha, and benzene (petroleum ether) were all stored on the property.

After the refinery operations ceased and most of the tanks and buildings were demolished and sold for scrap, the property was sold to private interests (EPA 2013a, 2015b). Beginning in 1975 with the construction of the church, private residences were constructed on six parcels of land that were part of the former refinery operations, with the most recent being constructed in 2004. One former building associated with the refinery was repurposed as a residence. As a result, there are seven residences on the site located within former tank or refinery operation areas. Three of the residences that are located on the eastern portion of the site (East Tank Farm) are known to use water from domestic/private wells.

1.2.3 Site Description

The location of the releases from the two refineries is considered to be a single site composed of a commingled release from the combined refinery operations threatening the same targets (Lockheed Martin SERAS [LMS] 2016; EPA 2013a, 2015b). The release from the two refineries is comingled and/or the contamination is contiguous. The Wilcox Oil site is composed of a release from the combined facility operations.

The site includes remnants of former oil refining operations and tank farms (LMS 2016; EPA 2013a, 2015b). The facility can be divided into five (5) major former operational areas (Figures 3 and 4): the Wilcox and Lorraine Process Areas, the East and North Tank Farms, and the Loading Dock Area. An active railroad divides the two former process areas and product storage areas.

- Wilcox Process Area – The Wilcox Process Area is fenced and spans approximately 26 acres. Most of the equipment and storage tanks that remained onsite in 1963 were auctioned and salvaged for scrap iron by private land owners; any remaining structures are in ruins. Four aboveground storage tanks (12,500-gallon capacity each) remain standing, in addition to a number of discarded drums and pieces of scrap iron and piping. A former Lead Additive area is present that is barren. There are multiple areas of stressed vegetation, barren areas, and visible, black tarry waste of a hydrocarbon nature. A building in the northern part of the former refinery has been converted to a residence. This building is currently vacant, as is a residence located in the eastern portion of the process area; however, the occupancy status of the residences onsite may change at any time. An intermittent creek (West Tributary) flows southward across the eastern portion of the refinery process area through a small pond in the southeast corner of the Wilcox Process Area into Sand Creek.

- Lorraine Process Area – The Lorraine Process Area spans approximately eight acres and covers the southwestern portion of the site, south of West 221st Street South (formerly Refinery Road) and west of the railroad tracks. No refinery structures remain in either the processing area or refined product storage area. The First Assembly of God Church (currently vacant), a playground, and a vacant residence (parsonage) are located in this area. A drainage feature borders the western boundary of the Lorraine Process Area and drains south to Sand Creek. There are multiple areas of stressed vegetation, barren soil, and visible, black tarry waste of a hydrocarbon nature. For the purposes of the RI, a portion of the North Tank Area has been re-designated as part of the Lorraine Process Area (Figure 4); the triangular-shaped section is south of Refinery Road and is located within the fenced compound that comprises the vacant First Assembly of God Church.

- East Tank Farm – The East Tank Farm spans approximately 80 acres and includes pits, ponds, and a number of circular berms that surrounded former tank locations. All of the former crude oil storage tanks have been removed; however, remnants of the former tank locations remain visible. It is not known if piping associated with the tanks remains in place underground or was removed. Many of the berms surrounding the pits, ponds, and former tanks have been breached or leveled. There are three occupied residences located on or directly next to former tank locations in the East Tank Farm. There are multiple areas of stressed vegetation, barren soil, and visible, black tarry waste of a hydrocarbon nature. Hydrocarbon waste has also been observed in several drainage channels that empty into Sand Creek. The East Tributary is located along the eastern boundary of the East Tank Farm and perennially flows south through a series of ponds to Sand Creek. Magellan Midstream Partners, LP operates a pumping station in the north-central portion of the East Tank Farm Area, as well as an active pipeline that transects the East Tank Farm, Loading Dock, and North Tank Farm Areas from the southeast to the northwest. Magellan Midstream Partners, LP has been known to pump several different petroleum products through the active pipeline, including kerosene, gasoline, jet fuel, and diesel.

- North Tank Farm – The North Tank Farm is located north of Refinery Road and west of the railroad tracks and spans approximately 20 acres. The North Tank Farm included crude oil and fuel oil storage tanks associated with the Lorraine Refinery. All of the tanks and other structures have since been removed. An occupied residence is located in the center of the North Tank Farm. There are areas of stressed vegetation, and visible, black tarry waste of a hydrocarbon nature.

- Loading Dock Area – The triangular-shaped Loading Dock Area spans approximately seven acres and is located north of Refinery Road and east of the railroad tracks. The Loading Dock Area was used for loading and unloading product by rail. There are multiple areas of stressed vegetation, barren areas, and visible black tarry waste of a hydrocarbon nature.

Current access to the property is not controlled, although portions of the site are fenced (LMS 2016; EPA 2013a, 2015b). A vacant church and seven residences (four of which are occupied at the time this SAP was written) are presently located on the facility. The seven residences are located on former crude oil storage tank or refinery operations areas. The three occupied residences located on the East Tank Farm are known to use water from domestic/private wells located onsite; the occupied residence in the North Tank Farm also uses water from a private well. The site is flanked by Route 66 to the west; a residential area and Turner Turnpike to the northwest and north; Sand Creek to the southwest; and residential, agricultural, and wooded areas to the east and south. The topography in the vicinity of the site slopes to the south. The drainage pattern of the property is primarily towards Sand Creek, which borders the western and southwestern boundaries of the property. An intermittent stream (West Tributary), a perennial stream (East Tributary), and several drainage channels transect the property east of the railroad (Wilcox Process Area and East Tank Farm), all of which flow into Sand Creek.

1.2.4 Historical Site Investigations

EPA and the Oklahoma Department of Environmental Quality (ODEQ) have conducted multiple investigations at the site beginning in 1994. The associated historical documents are as follows:

- Preliminary Assessment of the Wilcox Oil Company (Oklahoma Department of Environmental Quality [ODEQ] 1994)
- Expanded Site Inspection (ESI) Report – Wilcox Oil Company (Roy F. Weston 1997)
- Site Assessment Report for Wilcox Refinery (Ecology and Environment, Inc. [E&E] 1999)
- Preliminary Assessment of the Lorraine Refinery Site (ODEQ 2008)
- Site Inspection Report – Lorraine Refinery (ODEQ 2009)
- ESI Report – Lorraine Refinery (ODEQ 2010)
- ESI Report – Wilcox Refinery (ODEQ 2011a)
- Supplemental Sampling Report for Wilcox ESI (ODEQ 2011b).

Table 2 summarizes the most significant findings from these investigations.

On 24 May 2013, EPA proposed the site to the National Priorities List (NPL). On 12 December 2013, the site officially became a Federal Superfund site (EPA Identification No. OK0001010917), when it was added to the NPL.

During June 2015, EPA performed residential soil sampling. Areas in the proximity of 5 onsite and 4 offsite residences were sampled by collecting 5-point composites from each cell for grids comprised of 4 to 8 cells of varying size. Soil samples were collected from 0–2 inches below ground surface (bgs), 2–6 inches bgs, 0.5–1 foot (ft) bgs, and 1–2 ft bgs. Samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), pesticides, polychlorinated biphenyls (PCBs), and Target Analyte List (TAL) metals.

In October and December 2015, EPA expanded the site investigation under the Scientific, Engineering, Response and Analytical Services (SERAS) contract to include performing a geophysical survey, a Rapid Optical Scanning Tool (ROST) laser-induced fluorescence (LIF) survey, and a field-portable X-ray fluorescence (XRF) survey across portions of Wilcox and Lorraine Process Areas and the East Tank Farm. Samples of waste, soil, surface water, and infiltrated water were collected for laboratory analysis. This investigation is summarized in the following report, which was recently released:

- Trip Report (Draft): November 30 through December 16, 2015, Wilcox Oil Company Superfund Site (LMS 2016).

Data from these investigations will be used to design the RI approach; however, there are limitations with the data, as follows:

- Samples for all media were not analyzed for the full set of contaminants of potential concern (COPCs) at the site; the specific analytical suites are specified under the medium-specific discussion in this SAP.

- Detection limits for a number of historical analyses are too high in some cases to allow evaluation of data with respect to current risk-based screening levels; more recent analytical methods are able to yield lower detection limits.

- For metals and naturally-occurring radioactive materials (NORM)/technologically enhanced naturally-occurring radioactive materials (TENORM), detections are possible in all media sampled; analytical results indicate contamination likely occurred; however, no rigorous background or upstream concentrations have been derived and, for this reason, a definitive determination of presence and nature of contamination cannot be made.

- Field-portable XRF survey was performed in situ and no confirmation samples were submitted to the analytical laboratory for correlation with the field data; thus, a quantitative evaluation of the XRF data is not possible.

<u>ROST LIF Survey (December 2015)</u>

The ROST LIF study area covered a significant portion of the site and focused on areas where the contamination was most likely to have occurred (Lorraine Process Area, Wilcox Process Area, and East Tank Farm). The preliminary results of this survey are discussed in Section 1.1.5 for each source of contamination.

As summarized in the SERAS Trip Report (LMS 2016):

- "ROST utilizes LIF technology to introduce a laser into the subsurface. The laser excites hydrocarbon compounds, causing them to fluoresce. This fluorescence is then measured as a percent relative emittance (%RE). This %RE is based on a reference oil used to calibrate the ROST to '100%'. Different compounds and mixtures of compounds fluoresce differently. ROST uses four wavelengths of fluoresced light along with the intensity to provide a signature waveform for each mixture of hydrocarbon compounds. This waveform can be used to identify similar compound mixtures or mixtures which fluoresce in similar ways. This process can be used to identify areas impacted by different contaminants or multiple contaminant streams."

- "ROST detects double-ring polycyclic aromatic hydrocarbon (PAH) compounds. These compounds are present in all refined fractions, e.g. gasoline, kerosene, fuel oils, and lubricating oils, which makes ROST particularly suitable for assessing these mixtures. Of notable exception, however, are single-ring aromatic compounds (e.g. benzene, toluene, ethylbenzene, and xylene, etc.), which most refineries separate into their pure forms. If there is a release of pure benzene or other single-ring compound, it would not be detected by ROST."

- "ROST results will vary depending on soil type. For example, contaminants in sands and gravels can fluoresce an order of magnitude higher than the same contaminant in silts and clays."

- "ROST detects product or non-aqueous phase liquids, not dissolved phase compounds."

Soil sampling performed in December 2015 in conjunction with the ROST LIF investigation included the following (LMS 2016):

- Twenty-three soil samples analyzed for SVOCs, VOCs, and TAL metals; none of these samples were collected from the 0–2 ft bgs interval for residential exposure.

- One sand sample analyzed for SVOCs, VOCs, and TAL metals (surface sample)

- One pond discharge sample analyzed for SVOCs, VOCs, and total and dissolved metals

- Six samples coded as "ground water," but more representative of water infiltrated and ponded on top of the sandstone/clay layer, were analyzed for SVOCs, VOCs, and total and dissolved metals.

The samples collected in 2015 have not been analyzed for the full COPC suite for the site, and consequently, full characterization of the contamination at the locations sampled was not possible; moreover, heavier hydrocarbons, which are the more significant site COPCs, cannot be detected by this field screening technique. As a consequence, the ROST LIF survey output will be used as indicator data to guide the soil investigation in assessing potential source areas and delineate nature and extent of contamination at the site.

XRF Survey (December 2015)

Approximately 170 samples were analyzed for over 20 metal analytes via field-portable XRF; however, no split samples were sent to an analytical laboratory for confirmation analysis, so the XRF results are qualitative (LMS 2016).

As noted in the SERAS Trip Report (LMS 2016), "XRF technology is used to measure the concentrations of metals in soils either in-situ or in a laboratory setting. This technology uses an X-ray source to cause metals to fluoresce. This fluorescence is then detected by the XRF and resolved into concentrations of metals in the soil sample."

1.2.5 Sources of Potential Contamination

Primary sources of contamination are present at this site, ten of which were identified and evaluated in the Hazard Ranking System (HRS) Documentation Record for the site (EPA 2013a). In addition, industrial activities took place at various locations, but these locations are not identified as separate sources of contamination. This is due to the fact that significant demolition has taken place at the site and the specific locations could not be identified on a map.

Historical waste management practices are not known at this site. Historical Sanborn maps (Appendix E) were available for some areas of the site and were reviewed to identify the possible locations where contamination may have originated. Waste associated with crude oil refining may include the following: petroleum-related compounds, tank residues, crude oil, fuel oil, gas oil, petroleum distillate, kerosene, benzene, petroleum ether, brine, acid and caustic sludge, heavy metals, coke, sulfur compounds, solvents, and NORM/TENORM. Hexavalent chromium may be present where activities associated with cooling towers and cooling ponds took place. In addition, there is a possibility that PCBs and pesticides may have been used at the site, and as a consequence, they have been added to the list of COPCs. Multimedia samples will also be collected for analysis of dioxins and furans for completeness. In the case of hexavalent chromium, PCBs, pesticides, dioxin/furans, a smaller quantity of samples will be collected relative to the other COPCs, and limited to associated process areas where they are more likely to be detected. The sources of potential contamination are discussed in the following subsections.

1.2.5.1 Sources Associated with Refined Oil Operations – Lorraine Process Area

Based on available data, depth to bedrock/refusal varies widely across the Lorraine Process Area, between 3-5 ft bgs at the northwest corner to approximately 15 ft bgs for a significant portion of the process area.

The review of the 1923 Sanborn map (Appendix E) indicated the following potential source areas at the former Lorraine Refinery (LMS 2016):

- Several former aboveground storage tanks associated with refined petroleum products, including fuel oil, distillate, benzene, kerosene, and gasoline

- Former petroleum distillation process equipment that included stills, product rundown tanks, and agitator

- Former cooling tower and associated cooling pond (backfilled); these may be possible sources for hexavalent chromium.

Most tanks and stills were located on the northern portion of the property where the church, rectory, and parking lot are currently located. Storage tanks typically ranged in size from 100 to 2,000 gallons, with one 10,000-gallon fuel oil tank located on the southern portion of the property. Review of the most recent Sanborn maps available from 1941, 1956, and 1961 show no evidence of the former refinery.

During the 2015 investigation, the ROST rig was only able to access the northern two-thirds of the process area (Figure 5). Based on the ROST-LIF data, there is widespread hydrocarbon contamination in the northern half of the Lorraine Process Area. The associated sample data indicated a wide variety of petroleum hydrocarbon mixtures: (1) a lighter hydrocarbon fraction with some heavy constituents, consistent with a fuel oil or mixed hydrocarbon product; (2) mid-range to heavy organic constituents consistent with weathered crude oil and mixed hydrocarbon material; and (3) hydrocarbon compounds consistent with a refined product in the diesel range with possible mixing with other products/hydrocarbons.

XRF analysis of soil detected percent levels of lead within 1 foot of the surface at the northwest corner of the process area and in the vicinity of the former cooling tower and cooling pond.

A drainage pathway was evident that follows the location of the original county road shown on the 1923 Sanborn and the 1941 and 1956 aerial photographs (Figure 3; Appendix E).

A former cooling pond is located on the southwestern end of the former Lorraine Process Area (Figure 3) that was buried/backfilled. According to the 1923 Sanborn Map (Appendix E), the cooling pond measured approximately 90 ft by 100 ft (9,000 square ft) and was associated with a two nearby cooling tower, petroleum distillation equipment, and storage tanks.

During the December 2015 investigation (LMS 2016), a ROST LIF survey was performed in the area where the former cooling towers were located indicating that a possible release had occurred; however, the area where the former cooling pond was located was not investigated. A soil sample collected by direct-push was collocated with ROST LIF location LOR-25A at a depth of 12–14 ft bgs to correlate with percent fluorescence signature at this ROST LIF location. The soil sample was analyzed for TAL metals, SVOCs, and VOCs, but not for hexavalent chromium. Acenaphthylene, chloroethane, and fluorene were the only organic compounds detected, with concentrations estimated below analytical reporting limits; several metals were also detected or estimated. For metals, a comparison to background values would still need to be performed in order to confirm a release has occurred. Due to the depth (>10 ft bgs) from where it was collected, this soil sample would not be used to assess human health risk; however, the results can be used for evaluation of migration to ground water.

Additional COPCs other than those for which historical samples were analyzed apply to this source area and, for this reason, the historical data will only be used as a guideline for this RI. The COPCs for this process area include VOCs, PAHs, SVOCs, TAL metals (of note, the TAL metals list includes mercury), and cyanide. Soil samples collected in the vicinity of the former cooling tower/pond would also be analyzed for hexavalent chromium.

1.2.5.2 Sources Associated with Refined Oil Operations – Wilcox Process Area

Based on a review of Sanborn maps and historical aerial photographs (Figure 3; Appendix E), the following potential source areas were identified in the Wilcox Process Area:

- Several former aboveground storage tanks associated with refined petroleum products, including fuel oil, distillate, gasoline, naphtha, and kerosene
- Former petroleum distillation process areas that included distillation towers, stills, product rundown tanks, and steam plant
- Ethyl Blending Area
- Lead Additive Area that included acid tanks, agitators, and treaters
- Former Cooling Water/Makeup Water Pond, which may or may not be associated with one or more former cooling towers (possible source for hexavalent chromium)
- Two Produced Water Evaporation Ponds.

Conservatively, the COPCs for these source areas are the extended COPC suite: VOCs, PAHs, SVOCs, TAL metals, and cyanide. For completeness, additional COPCs are hexavalent chromium (due to the presence of the cooling towers…and the makeup pond?), PCBs, pesticides, dioxin/furans, and NORM/TENORM.

Historical data available for these source areas and their immediate vicinity are presented below and shown in Figure 3.

<u>Former Locations of Tank 18 and Tank19</u>

- Tanks 18 and 19 were located within the same bermed area.
- 1999: One boring (SB19) was installed southeast of this source area; two soil samples were collected from 1–2 ft bgs and 7–8 ft bgs. All samples were analyzed for benzene, toluene, ethylbenzene, and xylene (BTEX), PAHs, TPHs, metals, and pH. The surface soil sample contained several PAHs, TPH, and estimated concentrations of ethylbenzene, xylenes, and toluene. In the deeper sample, only one PAH was detected at an estimated concentration; however, the detection limits for PAHs were relatively elevated. The detections of metals have not been evaluated, as a background concentration is not available to determine if a release has occurred in this area (E&E 1999).

- 2015: One location by ROST LIF; no contamination was noted in this boring, but data are insufficient for a conclusive determination (LMS 2016).
- The nature and extent of contamination at this source area is not defined.

<u>Former Locations of Tank 20 and Tank 21</u>

- Tank 20 and Tank 21 were located within the same bermed area.
- 2015: ROST LIF data indicate contamination is present, but data are insufficient to delineate contamination (LMS 2016).
- The nature and extent of contamination at this source area is not defined.

<u>Former Locations of Tanks 22 through 29</u>

- Tanks 22 through 29 were located within the same bermed area.
- 2011: A soil sample (SS-3) collected during the ESI (ODEQ 2011a) that may have been located within this source area; several PAHs were detected.
- 2015: ROST LIF data indicate contamination is present, but data are insufficient to delineate contamination. One direct-push soil sample was collected from the south side of this source area between 7 to 10 ft bgs and analyzed for VOCs, SVOCs, and metals. Metals, VOCs (BTEX, chloroform, cyclohexane, 1,2-dichloropropane, isopropylbenzene, and methylcyclohexane), several PAHs, and dibenzofuran were detected in this sample (LMS 2016).
- The nature and extent of contamination at this source area is not defined.

<u>Former Locations of Tank 30 and Tank 31</u>

- 2011: A soil sample (SS-4) collected during the ESI (ODEQ 2011a) may be located within this source area; several PAHs were detected.
- ROST LIF data indicate contamination is present, but data are insufficient to delineate contamination (LMS 2016).

<u>Former Locations of Tank 32 and Tank 33</u>

- In the 1961 Sanborn map (EDR 2012) and older aerial photography, 10 smaller tanks were identified between these two tank locations.
- The presence or absence of contamination at this source area has not been confirmed.

<u>Former Location of Tank 34</u>

- 1999: One soil boring (SB14) was installed in the vicinity of this source area to the north-northeast; soil samples were collected form 1–2 ft bgs and 5–6 ft bgs. Soil samples were analyzed for BTEX, PAHs, TPH, metals, and pH. Both soil samples exhibited estimated detections of several PAHs and TPH. The detections of metals have not been evaluated, as a background concentration is not available to determine if a release has occurred in this area (E&E 1999).

- 2015: This location was investigated by ROST LIF, which confirmed the presence of contamination; however, the extent of contamination has not been fully delineated with this technology. One direct-push soil sample was collected from this source area from 6-8 ft bgs and analyzed for VOCs, SVOCs, and metals. Metals, VOC (BTEX, chloroform, cyclohexane, isopropylbenzene, and methylcyclohexane) and several PAHs were detected in this sample (LMS 2016).
- The nature and extent of contamination at this source area is not defined.

<u>Former Location of Tank 35</u>

- 2015: This location was investigated by ROST LIF and the presence of contamination is confirmed to the southeast; however, the extent of contamination has not been delineated with this technology (LMS 2016).
- The nature and extent of contamination in this source area is not defined.

<u>Former Location of Tank 36</u>

- 2015: This location was not investigated by ROST LIF.
- The presence or absence of contamination in this source area has not been confirmed.

<u>Former Location of Tank 37</u>

- 2015: This location was investigated by ROST LIF and no evidence of contamination has been confirmed (LMS 2016).

<u>Lead Additive Area (Doctor Process Area)</u>

- This location was initially suspected to be a fuel additives area (e.g., tetraethyl lead); however, further investigation indicates that area was more likely where the doctor process occurred to sweeten refined petroleum products (remove odorous mercaptans and other sulfur compounds).
- 2011: Analysis of surface soil samples detected lead concentrations ranging from 43,600 to 50,000 mg/kg (ODEQ 2011a).
- 2015: Field XRF investigation detected percent levels of lead in soil that attenuated with depth. Analysis of soil boring samples detected high levels of phenolic compounds. Analysis of water collected from piezometers detected concentrations of total and dissolved lead as high as 151,000 and 3,860 µg/L, respectively (LMS 2016).

1.2.5.3 Sources Associated with Crude Oil Operations – East Tank Farm and Wilcox Process Area

Several sources were identified as associated with crude oil storage based on Sanborn maps (Appendix E). These sources are the locations of former crude oil storage tanks where spills may have occurred. In many cases, the tank berms used to contain crude oil spills are still evident, as well as is waste consisting of an asphaltic or tar-like hydrocarbon material. Most of the crude oil storage tanks were located within the East Tank Farm; however, two tanks (Tanks 11 and 12) were located on the eastern portion of the Wilcox Process Area (Figure 3). The area of each tank berm area was estimated based upon the Sanborn maps and historical aerial photographs (Appendix E).

The COPCs for these source areas are VOCs, PAHs, SVOCs, TAL metals, and cyanide.

Historical data available for these source areas and their immediate vicinity are presented below and are shown in Figure 3.

<u>Former Location of Tank 2</u>

- This is the current location of Pond 4, which will also be investigated to assess impacts to surface water and sediment.
- The presence or absence of contamination at this source area has not been confirmed.

<u>Former Location of Tank 3</u>

- 1999: One boring was installed within the area of the source (SB05); three samples were collected from 1–2 ft bgs, 4–5 ft bgs, and 14–15 ft bgs. Five (5) additional borings (SB41 through SB45) were installed east, southeast, and south of the source area, and samples were collected from depths varying from 2–3 ft bgs to 6–7 ft bgs. All samples were analyzed for BTEX, PAHs, TPH, metals, and pH. Petroleum-odor was noted in SB05 and a hydrocarbon sheen was observed on the infiltration water that accumulated in the bottom of this boring. In all 3 soil samples collected from SB05, benzene, ethylbenzene, xylenes, several PAHs, and TPH were detected. Although no organics were detected in the samples collected from borings SB41 through SB45, the detection limits for PAHs were elevated and the heavier TPH fractions were not reported. The detections of metals have not been evaluated, as a background concentration is not available to determine if a release has occurred in this area (E&E 1999).
- 2010: A sample called "waste" was collected from the center of the tank location; only metals were detected. The sample was also analyzed for VOCs and SVOCs (ODEQ 2010).
- 2015: ROST LIF data indicate the presence of contamination in the center of this source; however, the presence of contamination is not delineated with this technology to the north, northeast, and east (LMS 2016).
- The nature and extent of contamination at this source area is not defined.

<u>Former Location of Tank 5</u>

- Early 2000s: The property owner confirmed that he dug the two existing onsite ponds.
- 2015: During the June 2015 residential soil sampling event, an oily sludge was observed at 1 and 1.5 ft bgs in the vicinity of former Tank 5. ROST LIF data indicate

the presence of contamination at this location to the east; however, the presence of contamination is not delineated with this technology to the north, south, and west (LMS 2016).

- The nature and extent of contamination at this source area is not defined.

<u>Former Location of Tank 6</u>

- 2010: A sample called "waste" was collected from the center of the tank location for analysis of metals, VOCs, and SVOCs; only metals were detected (source) (ODEQ 2010).
- 2015: ROST LIF data do not indicate the presence of contamination at this location (LMS 2016).
- The presence or absence of contamination at this source area is not confirmed.

<u>Former Location of Tank 7</u>

- 2015: ROST LIF data do not indicate the presence of contamination at this location (LMS 2016).
- The presence or absence of contamination at this source area is not confirmed.

<u>Former Location of Tank 8</u>

- 1999: One soil boring (SBX) was installed to the northwest of the source area; however, no samples are reported to have been analyzed per Table 4.1 of the report (E&E 1999).
- 2010: A sample called "waste" was collected from the center of the former tank location. Metals and several PAHs were detected, although VOCs were not (ODEQ 2010).
- 2015: ROST LIF data do not indicate the presence of contamination at this location but the survey was limited (LMS 2016).
- The presence or absence of contamination at this source area is not confirmed.

<u>Former Location of Tank 9</u>

- 1999: One boring was installed to the southwest of the source area berm (SB06), with a soil sample collected from 1–2 ft bgs and analyzed for BTEX, PAHs, TPH, metals, and pH. Several PAHs were detected in the surface soil sample from SB06. The detections of metals have not been evaluated, as a background concentration is not available to determine if a release has occurred in this area (E&E 1999).
- 2010: A sample called "waste" was collected from the center of the former Tank 9 location. Metals and several PAHs were detected, although VOCs were not (ODEQ 2010).
- 2015: ROST LIF data do not indicate the presence of contamination at this source area;

however, no ROST LIF points were installed to the west of the source area, where soil boring SB06 appears to have been installed in 1999 (LMS 2016).

- The nature and extent of contamination at this source area is not defined.

Tank Farm Area 10

- Currently, this area is partially covered with a sludge-like material.
- 1999: Waste was disposed of at this location; this area is described as a pit in the 1999 report (E&E), and the existence of a tank has never been confirmed. Two borings were installed: SB07 southwest of the berm, with a soil sample and a field duplicate collected from 4–5 ft bgs; and SB09 south of the source, with a sample collected from 1–2 ft bgs. The samples were analyzed for BTEX, PAHs, TPH, metals, and pH. Select PAHs were detected in both samples. The detections of metals have not been evaluated, as a background concentration is not available to determine if a release has occurred in this area.
- 2015: Due to the presence of waste sludge material at this source, the investigation by ROST LIF was limited in nature. Although the presence of contamination was confirmed at this location, delineation was not completed. From the aerial photographs, it appears this area was intended for use as a tank pad; however, it was apparently repurposed, as a separation pond or waste storage area (LMS 2016).
- The nature and extent of contamination at this source area is not defined, and characterization of the waste sludge is also necessary.

Former Location of Tank 11

- 1999: One boring (SB11) was installed within the area of the source within the berm, with a soil sample collected from 2–3 ft bgs. The sample was analyzed for BTEX, PAHs, TPH, metals, and pH. In all these soil samples, several PAHs were detected. The detections of metals have not been evaluated, as a background concentration is not available to determine if a release has occurred in this area (E&E 1999).
- 2015: ROST LIF investigation was focused in the center of the source area and to the south; the data indicate the presence of contamination in the center of this source. However, the presence of contamination is not delineated using ROST LIF to the northeast, east, and south. ROST LIF was not used in the location of the former 1999 boring location for SB11. Two direct-push soil samples were collected from this source area between 5 and 10 ft bgs and were analyzed for VOCs, SVOCs, and metals. Metals, three VOCs (cyclohexane, isopropylbenzene, and methylcyclohexane) and several PAHs were detected in these samples (LMS 2016).
- The nature and extent of contamination at this source area is not defined.

Former Location of Tank 12

- 1999: One boring (SB12) was installed in the southern portion of this source area within the berm; two soil samples were collected from 1–2 ft bgs and 8–9 ft bgs. The samples were analyzed for BTEX, PAHs, TPH, metals, and pH. No organic compounds were detected in this sample; however, the detection limits for PAHs were elevated and the heavier TPH fractions were not reported for this sample. The detections of metals have not been evaluated, as a background concentration is not available to determine if a release has occurred in this area (E&E 1999).

- 2015: ROST LIF data indicates the presence of contamination at this location; however, the source area was not delineated using ROST LIF technology. Three direct-push soil samples were collected from this source area from between 7 and 10 ft bgs and analyzed for VOCs, SVOCs, and metals. Metals, two VOCs (cyclohexane and isopropylbenzene), and several PAHs were detected in two of the samples, while only phthalates were detected in the third sample (LMS 2016).
- The nature and extent of contamination at this source area is not defined.

Former Location of Tank 13

- 2015: ROST LIF data do not indicate the presence of contamination at this location (LMS 2016).
- The presence or absence of contamination at this source area is not confirmed.

Former Location of Tanks 14 through 17

- These four aboveground storage tanks appear to have been located within the same bermed area.
- This source area was not investigated in the past.

1.2.5.4 Sources Associated with Crude Oil and Refinery Operations – North Tank Farm and Loading Dock Area

Based on a review of Sanborn maps (Appendix E), several former aboveground tanks were identified as sources associated with crude oil and fuel oil storage. No information is available regarding the raw materials or products managed at the Loading Dock Area. Past investigations did not include any sampling activities in either of these areas. Conservatively, the COPCs for these source areas are the extended COPC suite: VOCs, PAHs, SVOCs, TPH, TAL metals, and cyanide.

1.2.5.5 Sources Not Anticipated to be Associated with Refining Activities – East Tank Farm

Review of historical aerial photographs indicates that two locations on the extreme eastern boundary of the East Tank Farm may have been cleared for additional crude oil storage tanks; however, no historical data indicate that tanks were constructed or industrial activities took place in this area.
Due the low likelihood that these areas may have been used for industrial operations, the COPCs for these source areas are limited to VOCs, PAHs, SVOCs, TPH, TAL metals, and cyanide.

Results of historical investigations at these source areas are summarized below.

<u>Unconfirmed Location of Tank 1</u>

- 1999: No samples were collected from within the estimated footprint of this unconfirmed source area. However, three soil borings (SB36, SB37, and SB38) were installed in the vicinity of this potential source area, which is a cleared location where Tank 1 may or may not have been located. Samples collected from the subsurface (6–7 ft bgs) from SB36 and SB37, and from the surface (0–1 ft bgs) at SB38 were analyzed for BTEX, PAHs, TPH, metals, and pH. No detections of organic compounds were noted, but the detection limits for PAHs were relatively elevated and the heavier TPH fractions were not reported. The detections of metals have not been evaluated, as a background concentration is not available to determine if a release has occurred in this area (E&E 1999).
- 2015: This area was not investigated in 2015.

<u>Unconfirmed Location of Tank 4</u>

- 1999: No samples were collected from within the estimated footprint of this unconfirmed source area. However, two soil borings (SB39 and SB40) were installed in the vicinity of this potential source area, which is a cleared location where Tank 4 may or may not have been located. Samples collected from the subsurface (3-4 ft bgs) from each of these borings were analyzed for BTEX, PAHs, TPH, metals, and pH. No detections of organic compounds were noted, but the detection limits for PAHs were relatively elevated and the heavier fractions of TPHs were not reported. The detections of metals have not been evaluated, as a background concentration is not available to determine if a release has occurred in this area (E&E 1999).
- 2015: This area was not investigated in 2015.

1.2.5.6 Waste Sources

Several waste piles or areas of exposed waste material have been observed onsite. Waste piles located in the following areas will be investigated to include assessing subsurface soil for contaminant leaching:

- Waste observed within the former location of crude oil storage tank in North Tank Farm
- Waste observed along the railroad tracks in the Loading Dock Area
- Waste pit (Former Pond 1) located in the East Tank Farm
- Waste observed within the former location of Tank 10 in the East Tank Farm
- Waste observed in drainage pathways leading from process areas to Sand Creek.

The COPCs for waste are: VOCs, ethylene dibromide (EDB), PAHs, SVOCs, TPH, TAL metals, and cyanide. For completeness, additional COPCs are PCBs, pesticides, dioxins/furans, and NORM/TENORM.

Previous work conducted within specific waste source areas that will be characterized are summarized below.

<u>Former Location of Pond 2</u>

- 1999: Three soil borings were installed in the vicinity of this source: SB08 with a sample collected from 1–2 ft bgs, SB35 with a sample collected from 0 to 3 ft bgs, and SB46 with a sample collected from 6–12 ft bgs. Samples were analyzed for BTEX, PAHs, TPH, and metals. Only metals and an estimated, biased high concentration for pyrene in SB35 were detected in these samples (E&E 1999).
- 2015: One soil sample (P-03-SAND) was collected from the southwest side of this area from the surface (0 ft bgs) and was analyzed for VOCs, SVOCs, and metals. Only metals were detected in this sample (LMS 2016).

<u>Former Location of Pond 1</u>

- 1996: Two waste samples were collected from tar-like seeps on the surface of the former pond; VOCs and SVOCs were detected in samples, with some PAHs at concentrations above current EPA residential risk-based screening levels (Weston 1997).
- 1999: Three soil borings were installed in the vicinity of this source: SB02 with a sample collected from 1–2 ft bgs, SB03 with a sample collected from 1.5 to 2 ft bgs, and SB04 with a sample collected from 4–5 ft bgs. Samples were analyzed for BTEX, PAHs, TPH, and metals. Only metals were detected in these samples (E&E 1999).
- 2015: Test pits were excavated around the perimeter of the former pond. One soil sample (P-04-01) was collected from within the source area from 3.5 to 4.5 ft bgs and analyzed for VOCs, SVOCs, and metals. Metals, several PAHs, and dibenzofuran were detected in this sample (LMS 2016).

Additional waste samples were collected from the East Tank Area in 2010 (ODEQ 2010); there is insufficient information to determine if these samples were of contaminated soil or actual waste material, as no description of the sample matrix is available. The samples were analyzed for VOCs, SVOCs, and metals, and several PAHs were detected in two of the samples.

1.2.5.7 Sources Not Differentiated

Conservatively, the COPCs for these source areas are the extended COPC suite: VOCs, EDB, PAHs, SVOCs, TPH, TAL metals, and cyanide. For completeness, additional COPCs are PCBs, pesticides, dioxins/furans, and NORM/TENORM.

In addition to the waste areas identified above, there are other historical sources of contamination located within Wilcox and Lorraine Process Areas, as well as in the East Tank Farm. However, due to the significant demolition that took place at the site over the years, as well as changing of tank placement and storage area configurations in the East Tank Farm, specific locations could not be identified. Other areas that may have been impacted by site COPCs include the drainage pathways leading from source areas to the surface water bodies. The most prominent of these drainage pathways lead from the Wilcox Process Area and East Tank Farm southward to Sand Creek. These remaining areas will be characterized in a different manner than the distinct source areas. Throughout the investigation, the field crew will make observations regarding the presence of underground features, such as buried piping that was not identified during the 2015 geophysical survey.

Additional analytical data for soil samples collected from the Wilcox Process Area are summarized below:

- 1999: BTEX, PAHs, and TPH were detected in soil samples collected from numerous locations, many of which were generally shallow (within the 0-3 ft bgs interval) (E&E 1999).
- 2015: In addition to the samples discussed above, nine soil samples were collected from this area at depths spanning 5 to 15 ft bgs; samples were analyzed for VOCs, SVOCs, and metals. VOCs (benzene, isopropylbenzene, and xylenes) and phenol (an SVOC) were detected in two of these samples (WIL-AA-10 and WIL-AA-11) that were collected from the vicinity of the lead mixing area. In the remainder of the samples, metals, VOCs (acetone, BTEX, 2-butanone, cyclohaxane, 1,2-dichloropropane, isopropylbenzene, methylcyclohexane, and methylene chloride), several PAHs, and several SVOCs (1,1'-biphenyl, 1,4-dioxane, bis[2-ethylhexyl]phthalate) were detected (LMS 2016).

Additional analytical data for soil samples collected from the Lorraine Process Area in 2015 are summarized below:

- In addition to the samples discussed above, four soil samples were collected from this area at depths spanning 6 to 14 ft bgs. Metals, VOCs (cyclohexane, isopropylbenzene, and methylcyclohexane), several PAHs, and dibenzofuran were detected in these samples (LMS 2016).

1.3 DESCRIPTION OF PROJECT OBJECTIVES AND TASKS

This section describes the project objectives and tasks for this SAP.

1.3.1 Project Objectives

The primary objectives of the RI are to characterize source material; determine the nature and extent of contamination; evaluate fate and transport of contamination and the migration pathways; conduct human health and ecological risk screenings; and, if risk screenings indicate exceedances of the conservative screening levels or background/reference values, perform human health and ecological risk assessments to determine if a risk is present from former site operations. Ultimately, the goal is to gather sufficient information so that the EPA, in case of a risk remaining at the site, can select a remedy that eliminates, reduces, or controls risks to human health and the environment. The following components are considered key to conducting a RI for the site:

- Data collection for media characterization for definition of nature and extent of contamination; collection of other supporting data

- Risk screening, and if necessary, performance of risk assessments for human health and the environment

  - Human Health Risk Assessment (HHRA) to characterize and quantify the current and potential human health risks that would prevail if no remedial action were taken.
  - Screening Level Ecological Risk Assessment (SLERA) to characterize and quantify the current and potential ecological risks.

- Production of a RI Report that accurately establishes site characteristics, including identification of source materials as applicable, definition of the nature and extent of contamination, and evaluation of migration pathways. The RI provides information to assess risks to human health and the environment, and to support the development, evaluation, and selection of appropriate response alternatives.

- Project Close-out includes the activities necessary to close out the Task Order in accordance with contract requirements.

1.3.2 Project Tasks

The following RI components will be completed upon EPA direction:

- Project planning and support
- Field investigation/data acquisition
- Sample analysis
- Analytical support and data validation
- Data evaluation
- Risk assessment
- RI Report preparation
- Task order closeout.

Based on the preliminary review of the data, it is proposed that the RI be performed in several mobilizations, such that the need for data collection for mobilization 2 and 3, if necessary, is based on the results of the previous mobilization. The staging of the investigation is presented below.

1.3.2.1 Mobilization Event 1

Mobilization Event 1 will include the following field activities:

1. Assist the EPA Environmental Response Team (ERT) with passive soil gas (PSG) investigation of Lorraine Process Area, Wilcox Process Area, and East Tank Farm; PSG samples will be analyzed for the mass content of BTEX, naphthalene, and 2-methylnaphthalene to provide information regarding the presence of volatile components in soil gas.

2. Clear buried and overhead utility locations.

3. Set up onsite facilities.

4. Clear vegetation on two properties: Wilcox Processing Area (former Wilcox Refinery) and former Lorraine Refinery (southern portion). Other areas will be cleared as needed for access during site reconnaissance and waste delineation, including the North Tank Farm and Loading Dock Area.
5. Perform a site reconnaissance with the following goals:
   a) Assess if there is evidence that the two bermed areas (unconfirmed Tanks 1 and 4) in the eastern portion of the East Tank Farm areas have been used for industrial activities.
   b) Assist ODEQ in using a thermal infrared imaging camera to determine the location of the seeps and locations where runoff from the site drains into Sand Creek, including the East Tributary (probable point of entry [PPE]); also, reconnoiter the PPE of the West Tributary into Sand Creek. This information will be used to determine the potential locations for surface water/sediment sampling in order to optimize the sampling strategy and eliminate duplication of effort.
   c) Perform wetlands survey to confirm presence of a sensitive environment.
   d) Supervise subcontractor performance of a suspected asbestos-containing material (ACM) survey and collect samples for testing, if applicable.
   e) Perform field screening activities using field instruments and detectors to identify the possible presence and degree of NORM/TENORM in coal tar-coated piping, sludge ponds, and separation ponds. Note that further assessment for the presence of NORM/TENORM in soil, surface water, sediment, and ground water exposure media will be performed only if the field screening performed during the reconnaissance indicated NORM/TENORM is present. If confirmed, a subset of the multimedia samples collected during Mobilization 1 will be also analyzed for NORM/TENORM.
   f) Coordinate with Oklahoma Department of Transportation (ODOT) to (1) visually assess the Sand Creek bridge that was constructed using onsite borrow material; and possibly select locations for sampling using a hand auger or similar coring device.
   g) Reconnoiter the large field across Refinery Road from the East Tank Farm (just north

of Former Tank 5), which is currently proposed for soil background sampling. Assess if this area has evidence of anthropogenic activities and confirm location is adequate for background sampling; if not, select another location.

h) Confirm how many residences have private water supply wells and obtain consent to sample their wells in coordination with ODEQ.

i) Locate the three inactive private wells (church well located at the Lorraine Process Area and two wells located on the East Tank Farm), and determine if pumps are present; if possible, gauge the wells using a water level indicator and/or interface probe.

j) Identify additional waste piles and areas of exposed waste material. Delineate the waste piles using Global Positioning System (GPS) and visually assess how many types of waste may be present in each pile.

k) Identify sandstone outcrops in the North Tank Farm area to determine overburden depths.

6. Perform soil investigation:

a) Install soil borings to horizontally and vertically delineate the contamination is soil; ROST LIF fluorescence signature outputs from the Lorraine Process Area, Wilcox Process Area, and East Tank Farm (Tanks 3 and 5 only) will be utilized as a starting point for the delineation. Surface and subsurface soil samples will be collected from the borings at select intervals for analysis for VOCs, SVOCs (including SIM for PAHs), TAL metals, cyanide, and hexavalent chromium (at locations in the vicinity of the former cooling towers and associated cooling ponds).

b) Install soil borings and collect surface and subsurface soil samples in areas where a ROST LIF survey has left data gaps or was not performed and/or in areas where source areas may have been located at the Lorraine Process Area (former cooling towers/pond and Tank 38 location) and Wilcox Process Area (distillation process areas and former cooling towers/pond). Soil samples will be analyzed for VOCs, SVOCs (including SIM for PAHs), TAL metals, cyanide, and hexavalent chromium (vicinity of former cooling towers and associated cooling ponds).

c) Install soil borings and collect surface and subsurface soil samples between suspected source areas and Sand Creek to evaluate surface/subsurface migration to surface water. If infiltrated water is identified in soil borings, install piezometers to evaluate potential seepage to Sand Creek. Piezometer water levels will be monitored and water samples will be collected for analysis for VOCs, SVOCs (including SIM for PAHs), TAL metals, cyanide, and hexavalent chromium. The soil samples will be analyzed for the same COPC suite.

d) Aliquots for analysis for PCBs, dioxins/furans, and pesticides in soil will be collected from shallow horizons at 10 sample locations in the Wilcox Process Area.

e) Based on reconnaissance information, install soil borings and collect surface and subsurface soil samples to assess Former Tanks 1 and 4 (located on the east side of East Tributary) for analysis for VOCs, SVOCs (including SIM for PAHs), and TAL metals.

f) Assist EPA Headquarters representatives with XRF delineation of Lead Additive Area (Wilcox Process Area).

g) Perform a soil background assessment for PAHs and metals (0 – 0.5 ft bgs) using incremental composite sampling (ICS) methodology. The background soil assessment will also include NORM/TENORM, if it is determined to be present during the initial reconnaissance survey.

h) Soil investigation may be refined based on findings of EPA ERT's PSG investigation.

7. Initial ground water assessment:

   a) Investigate and sample inactive private water supply wells, including the LNAPL-impacted well located in Lorraine Process Area. Investigation of each well may include (1) evacuating the well adequately to remove, sample, and characterize LNAPL (if present); (2) gauge the well using an interface probe to determine presence and thickness of LNAPL (if present); (3) log the well to determine well construction, lithology, and flow using video camera, temperature and fluid conductivity probe, and/or geophysical logging tool; and (4) and collect a representative ground water sample (if possible) for analysis for VOCs, EDB, SVOCs (including SIM for PAHs), TAL metals, cyanide, and hexavalent chromium.

   b) Coordinate with ODEQ to resample the 10 on- and offsite residential wells that were sampled in 2010; if additional wells are identified during site reconnaissance, include them in the sampling effort and analyze the ground water samples for VOCs, EDB, SVOCs (including SIM for PAHs), TAL metals, cyanide, and hexavalent chromium.

   c) Sample two wells located in East Tank Farm that are currently not in use for VOCs, SVOCs (including SIM for PAHs), TAL metals, and cyanide. These inactive wells may also be logged as described for the Lorraine well pending availability of funding and schedule).

   Sample residential well located at residence on North Tank Farm for VOCs, SVOCs (including SIM for PAHs), TAL metals, cyanide, and hexavalent chromium.

8. Survey and catalog relevant site features and sampling locations using GPS.

9. Perform soil gas and vapor intrusion sampling at the two vacant residences and the vacant church located on the Lorraine and Wilcox Process Areas and analyze samples for VOCs and naphthalene (pending funding availability and schedule); this investigation may be refined based on findings of EPA ERT's PSG investigation.

10. Perform surface water and sediment investigation (pending funding availability and schedule):
    a) Collect surface water and sediment samples to assess conditions along Sand Creek, West and East Tributaries, ponds located along the streams, isolated ponds, and the Sand Creek bridge (in coordination with ODOT, as appropriate).
    b) Collect surface water and sediment samples to determine upstream conditions for Sand Creek and the tributaries and background conditions for the isolated ponds.
    c) Surface water samples will be analyzed for VOCs, SVOCs (including SIM for PAHs), total and dissolved TAL metals, cyanide, and hexavalent chromium (10 percent), as well as surface water quality parameters.
    d) Sediment samples will be analyzed for VOCs, SVOCs (including SIM for PAHs), TAL metals, cyanide, and AVS/SEM.

1.3.2.2 Mobilization Event 2

Mobilization Event 2 may include the following field activities contingent on findings of Mobilization 1 investigation (will require SAP revision):

1. Additional clearing of vegetation on the North Tank Farm and Loading Dock Area, as necessary.

2. Expand the PSG investigation based on findings of EPA ERT's initial PSG investigation.

3. Based on Mobilization 1 findings, refine COPC list and define appropriate decision units in Lorraine Process Area, Wilcox Process Area, and East Tank Farm for surface soil investigation (0 – 2 ft bgs) using ICS methodology. ICS soil data will be used to characterize source areas and assess residential human health risk.
4. Based on Mobilization 1 soil investigation, reconnaissance, and waste area delineation, refine the COPC list and investigate the North Tank Farm and Loading Dock Area soils using ICS methodology.

5. Perform initial surface water and sediment investigation if not completed under Mobilization 1. If initial investigation completed during Mobilization 1, then use data to refine the COPC list and expand sampling downstream, as appropriate, so that surface water and sediment impact can be delineated.

6. Characterize surface soil in drainage pathways leading from source areas to Sand Creek using ICS methodology. Samples from these drainage pathways were called sediment in past investigations; however, they are representative of the soil exposure medium as the ground is only.

7. Based on information obtained from the ground water investigation performed during Mobilization Event 1, determine the locations for new monitoring well locations. Install

and develop the new monitoring wells, and collect ground water samples. Survey the wells and gather additional information for the characterization of the hydrologic regime so the potential for seasonal fluctuations is assessed.

8. Plug and abandon the private water supply well located on the Lorraine Process Area.

9. Perform soil gas and vapor intrusion sampling at two vacant residences and the vacant church located on the Lorraine and Wilcox Process Areas and analyze samples for VOCs and naphthalene if not completed under Mobilization 1; this investigation may be refined based on findings of EPA ERT's PSG investigation. If initial investigation is completed during Mobilization 1, then, based on the results of initial soil gas and vapor intrusion sampling, perform a second round of vapor intrusion sampling at residences and buildings associated with the church to evaluate seasonal variation (if warranted), and expand the soil gas and vapor intrusion investigation to occupied residences located on the East Tank Farm and North Tank Farm.

10. Perform characterization (sampling) of waste areas by collecting surficial samples for the complete suite of site COPCs.

11. If suspected ACM is confirmed to be present through sampling performed by a subcontractor during Mobilization Event 1, follow up on ACM removal.

1.3.2.3 Mobilization Event 3

Mobilization Event 3, if deemed necessary, will include the following field activities:

1. Field activities will entail further delineation of impact to ground water and additional gauging of existing and installed wells to assess seasonal variations. The SAP will require revision to address the sampling and analytical approach for Mobilization 3.

2. Based on the results of the first or second soil gas and vapor intrusion investigation, perform additional vapor intrusion sampling to evaluate seasonal variation.

3. Collection of samples for ecological assessment (fish tissue, plant tissue, and/or sediment for toxicity testing, if warranted); locations will be selected based on soil/sediment/ surface water analytical results obtained during prior mobilizations.

1.4 DATA QUALITY OBJECTIVES

The following sections present the DQOs for this project. The SOW issued by the EPA (2015b), the EPA-approved Work Plan (EA 2015), and the preliminary Conceptual Site Model (CSM) (Appendix A) form the basis for the DQO assessment. This DQO assessment follows EPA's 7-step DQO process (Table 3), which is outlined in *Guidance on Systematic Planning Using the Data Quality Objectives Process (QA/G-4)* (EPA 2006a) and *Systematic Planning: A Case Study for Hazardous Waste Site Investigations (QA/CS-1)* (EPA 2006b).

Additional information is referenced, as appropriate, in the following sections:

- Section 1.3.1 Purpose and Goal
- Section 1.3.2 Step 1 – State the Problem
- Section 1.3.3 Step 2 – Identify the Goal of the Study
- Section 1.3.4 Step 3 – Identify Information Inputs
- Section 1.3.5 Step 4 – Define the Boundaries of the Study
- Section 1.3.6 Step 5 – Develop the Analytical Approach
- Section 1.3.7 Step 6 – Specify the Performance or Acceptance Criteria
- Section 1.3.8 Step 7 – Develop the Plan for Obtaining Data.

1.4.1 Purpose and Goal

The purpose of defining the DQOs is to support decision-making by applying a systematic planning and statistical hypothesis-testing methodology to decide between alternatives. The goal is to develop an analytical approach and data collection strategy that is effective and efficient.

1.4.2 Step 1 – State the Problem

The first step in systematic planning process, and therefore the DQO process, is to define the problem that has initiated the study. As environmental problems are often complex combinations of technical, economic, social, and political issues, it is critical to the success of the process to separate each problem, define it completely, and express it in an uncomplicated format.

The activities in DQO Step 1 are as follows:

- Give a concise description of the problem
- Identify a leader and members of the planning team
- Develop a CSM of the environmental hazard to be investigated
- Determine resources (i.e., budget, personnel, and schedule).

1.4.2.1 Problem Description

Industrial/manufacturing processes at the Site have resulted in a release of contaminants to media creating primary sources of contamination. Contamination is present at five separate areas at the site that has migrated from the known sources of contamination to the environment. These areas are the Wilcox Process Area, Lorraine Process Area, East Tank Farm, North Tank Farm, and Loading Dock Area. Contamination has been documented at the site through sampling and analysis of soil, surface water, sediment, and waste (Sections 1.1.4 and 1.1.5). However, the nature and extent of media impacted by site COPCs, possible migration of impacted media, and risks associated with impacted media are unknown. The transport mechanisms, exposure media, and receptors are detailed according to the CSMs for human health and the environment as presented in Appendix A to this plan.

The current land use across the site is residential; however, the possibility exists that the process areas may be zoned as commercial/industrial in the future. Short term exposure of construction workers and trespassers to contaminated soil is also considered, as is infrequent recreational use of the area. Data will also be collected to assess a risk to ecological receptors.

The current COPCs at the site are as follows:

- VOCs
- EDB
- PAHs
- SVOCs
- TAL metals
- Cyanide.

In addition, for completeness, a select number of shallow surface soil samples (0.0–0.5 ft bgs) from the process areas will undergo the following analyses:

- Hexavalent chromium
- PCBs
- Pesticides
- Dioxins/furans
- NORM/TENORM (if necessary, based on survey results).

Additional analyses will be performed on samples collected from the site for the RI; they are discussed in detail in Section 2.2.

As noted in Section 1.2.2, Project Tasks, a staged approach is taken for the characterization of the site. Specific items will be investigated during Mobilization 1 that will provide data to inform the next steps (subsequent mobilizations) in the RI. The problems or data gaps that will be addressed during either Mobilization 1 and/or Mobilization 2 are summarized below.

<u>Soil Exposure Medium</u>

- Semi-quantitatively assess presence of volatile COPCs in subsurface (Mobilization 1).
- Use existing ROST LIF and XRF data to direct the assessment of potential source areas in the Lorraine Process Area, Wilcox Process Area, and East Tank Farm and delineate nature and extent of contamination (Mobilization 1).
- Assess potential source areas that were not investigated using ROST LIF (Lorraine and Wilcox Process Areas) (Mobilization 1)
- Assess if contamination is present at former locations for Tanks 1 and 4, located east of the East Tributary (Mobilization 1).
- Establish background values for PAHs, metals, and NORM/TENORM, as applicable (Mobilization 1).

- Use ICS methodology to characterize contamination in surface soil (0 – 2 ft bgs) across the Lorraine Process Area, Wilcox Process Area, and East Tank Farm to evaluate human health and ecological risk in exposure units defined using Mobilization 1 data (Mobilization 2).
- Confirm presence of contamination in soil below waste piles across the site (Mobilization 2).
- Characterize the most likely areas to be contaminated at the North Tank Farm (Mobilization 2).

Assess soil in drainage pathways that channel surface runoff from sources of contamination to the tributaries (Mobilization 2).

<u>Surface and Sediment Exposure Media</u>

- Identify seeps and discharges from the site into Sand Creek (Mobilization 1).
- Assess if contamination from source areas is migrating to Sand Creek (Mobilization 1).
- Evaluate impacts to surface water and sediment along Sand Creek, intermittent tributary, perennial tributary, and ponds (Mobilization 1 and/or 2).
- Evaluate upstream surface water and sediment quality and background pond sediment and surface water quality (Mobilization 1 and/or 2).

<u>Ground Water Exposure Medium</u>

- Investigate the interaction of the contaminated infiltrated water (if present) on top of the sandstone or clay layer and the underlying regional aquifer (Mobilization 1 and/or 2).
- Determine nature and extent of contamination in ground water (Mobilization 1 and 2).
- Investigate the interaction between surface water and ground water (Mobilization 1 and 2).

<u>Air Exposure via Vapor Intrusion Medium</u>

- Semi-quantitatively assess presence of volatile COPCs in subsurface (Mobilization 1).
- Determine if vapor intrusion is a concern on several properties at the site (Mobilization 1 and/or 2).

<u>Waste Material</u>

- Identify and visually delineate waste piles and areas of exposed waste material across the site (Mobilization 1).
- Characterize waste piles and areas of exposed waste material across the site and assess impacts to soil immediately below the waste piles (Mobilization 2).

Surveys to Determine Presence of Other Contaminants or Other Media Requiring Characterization

- Evaluate whether NORM/TENORM are present at the site (Mobilization 1).
- Evaluate whether asbestos is present at the site (Mobilization 1).
- Confirm the presence of wetlands that are referenced in the HRS Documentation Record (EPA 2013a) (Mobilization 1).

1.4.2.2 Planning Team Members and Stakeholders

A proven, effective approach to formulating a problem and establishing a plan for obtaining information that is necessary to resolve the problem is to involve a team of experts and stakeholders that represent a diverse, multidisciplinary background. Such a team provides the ability to develop a concise description of complex problems, and multifaceted experience and awareness of potential data uses. Planning team members (including the leader) and stakeholders are presented below.

Planning Team Members

- Katrina Higgins-Coltrain, EPA Region 6 TOM
- Philip Turner, EPA Region 6 Risk Assessor
- Thomas Kady, EPA Environmental Response Team
- Barry Forsythe, U.S. Fish and Wildlife Service
- Todd Downham, ODEQ
- Teresa McMillan, EA.

Stakeholders

- EPA Region 6 Superfund Division Management
- EPA Headquarters
- U.S. Fish and Wildlife Service
- ODEQ
- Interested tribal nations (Cherokee Nation, Muskogee [Creek] Nation, Sac and Fox Nation)
- City of Bristow, Oklahoma
- Other interested parties, such as residents living at the site.

If additional planning team members and/or stakeholders are identified as the RI progresses, they will be incorporated into the decision-making process as appropriate.

1.4.2.3 Conceptual Site Model

It is critical to carefully develop an accurate CSM of the environmental problem, as this model will serve as the basis for subsequent inputs and decisions. Details on the CSM for the site and diagrams for the human health and ecological receptors are included in Appendix A to this SAP.

As described in Section 1.1.4 and in Table 2, the presence of organic contaminants—PAHs in particular—are confirmed to be present in waste materials, soil, and sediment samples associated with the site. Metals were detected in samples collected from all media, but because metals are naturally occurring, a more rigorous study would be necessary to determine if elevated concentrations (above background) are due to site activities or from contamination migrating to the site from other refineries in the area.

Data to be collected during the RI effort will be used to supplement existing data and resolve data gaps relating to nature and extent of contamination in all media, including presence of contaminants in air within select buildings, potential ground water plumes, and hot spot delineation. The following potential migration pathways of impacted media have been identified and will have to be evaluated: (1) infiltration to subsurface soil, (2) transport of contamination to surface water and sediment via infiltrated contaminated water, (3) transport of contamination downstream via surface water and sediment; (4) leaching to ground water, (5) interaction of surface water and ground water, and (6) ground water transport. Data will be screened against conservative screening levels and, if potential unacceptable risks to human health or ecological receptors are identified as a result of exposure to COPCs in site-related media, a human health and/or ecological risk assessment will be performed.

Additional details pertaining to the CSM are provided in the attached CSM Technical Memorandum (Appendix A) and are not repeated here for brevity.

1.4.2.4 Determine Resources

Resources should be identified by the planning team so that constraints (e.g., budget, time, etc.) associated with collecting/evaluating data can be anticipated during the project life cycle. To assist in this evaluation, the DQO process (e.g., developing performance or acceptance criteria) and the SAP (i.e., for collecting and analyzing samples, and interpreting and assessing the collected data) have been completed.

EA personnel, team subcontractor personnel, and/or non-team subcontractor personnel with appropriate oversight will perform data collection tasks with the following possible exceptions:

- EPA ERT contractor has been tasked with implementing the PSG investigation prior to EA's Mobilization 1 activities, with support from EA as necessary.
- U.S. Geological Survey may be tasked with performing geophysical and camera logging of site water supply wells, with support from EA as necessary.

- EPA Headquarters has been tasked with implementing the investigation of the Lead Additive Area, with support from EA as necessary.
- ODEQ has been tasked with using their thermal infrared imaging camera to identify possible seeps along Sand Creek, with support from EA as necessary.

EA will utilize the services of the EPA's Region 6 Houston Laboratory or the EPA Contract Laboratory Program (CLP), where feasible. When samples cannot be analyzed by either the EPA Region 6 Laboratory or the CLP, due to method requirements, schedule requirements, or elevated analyte concentrations, a non-CLP commercial laboratory will be subcontracted by EA to support the analyses. Data generated by the EPA Region 6 Laboratory or CLP will be validated by EPA or EPA contractors. Data generated by the EA-subcontracted laboratory will be validated by EA personnel or subcontracted personnel.

The EPA will perform a review of each required deliverable and provide comments, as necessary. EPA will also solicit comments from other planning team members or stakeholders, as appropriate.

1.4.3 Step 2 – Identify the Goal of the Study

Step 2 of the DQO process involves identifying the key questions that the study attempts to address, along with alternative actions or outcomes that may result based on the answers to these key questions. These two items are combined to develop decision statements, which are critical for defining decision performance criteria later in Step 6 of the DQO process.

The activities in DQO Step 2 are as follows:

- Identify principal study questions (PSQs)
- Consider alternative actions that can occur upon answering the questions
- Develop decision statement(s) and organize multiple decisions.

1.4.3.1 Principal Study Questions

The PSQs define the questions to be answered by the HHRA, SLERA, and RI following completion of the field program (Mobilizations 1 through 3). The PSQs are as follows:

- Are waste piles Resource Conservation and Recovery Act (RCRA) hazardous or non-hazardous and have contaminants leached from the waste into the underlying soil layer?
- What is the nature of contamination in soil within specific source areas and what is the extent of contamination?
- What is the nature of contamination in surface water and sediment and what is the extent?
- What is the extent and volume of contaminated media in the Lead Additive Area?
- Is there a ground water aquifer at the site, and if present what is the classification and what is the nature and extent of contamination?

- Is there LNAPL present and what is the extent and volume?
- Is the refusal layer continuous across the site and does it provide a barrier to downward contaminant migration?
- Is vapor intrusion an issue at select properties?
- What are the migration pathways for transport of these contaminants in different media?
- Are asbestos and/or NORM/TENORM present at the site?
- Are wetlands present at the site?
- Is there a risk to human health or the environment from contamination at the site?

1.4.3.2 Alternative Actions

The alternative actions provide PSQ alternatives in the FS, as follows. Potential alternative actions, which will be evaluated in the FS, include, but are not limited to, the following:

- Remove or remediate the source areas.
- Restrict access to limit exposure.
- Mitigate migration pathways.
- Address other migration/exposure pathways impacting receptors by employing engineering or institutional controls.

1.4.3.3 Decision Statement

For decision-making problems, the PSQs and alternative actions are combined to develop decision statements, which are critical for defining decision performance criteria in DQO Step 6. This RI field program is planned to be implemented in up to three mobilizations, where data from Mobilization 1 will be utilized to plan specific activities in the subsequent Mobilization 2 and Mobilization 3, if necessary. The decision statements for the RI field program (Mobilizations 1 through 3) are as follows:

- Delineate and characterize waste piles and underlying soil.
- Determine if ROST LIF data are adequate to characterize the nature and extent of contamination in surface and subsurface soil and use that information to continue delineation of contamination and soil sampling.
- Characterize and delineate soil contamination at specific source areas.
- Characterize and delineate contamination in surface water and sediment.
- Characterize and delineate contamination to determine how and what future actions (e.g., investigation, delineation, characterization) are necessary to characterize the ground water; otherwise, consider no further action.

- Characterize and delineate contamination in ground water to determine whether COPCs present unacceptable human health/ecological risk requiring the evaluation of options and technologies to support future actions (e.g., removal, remediation, exposure restriction, migration mitigation, or in-place containment); otherwise, consider no further action.
- Confirm the presence or absence of ground water contamination discharge to the surface water to determine how and what future actions (e.g., investigation, delineation, characterization) are necessary to characterize this interaction; otherwise, consider no further action.
- Characterize and delineate ground water discharge to surface water to determine whether COPCs present unacceptable human health/ecological risk requiring the evaluation of options and technologies to support future actions (e.g., removal, remediation, exposure restriction, migration mitigation, or in-place containment); otherwise, consider no further action.
- Confirm the presence or absence of LNAPL to determine whether future actions (e.g., removal, remediation, exposure restriction, migration mitigation, or in-place containment) are necessary; otherwise, consider no further action.
- Characterize and delineate the LNAPL to determine whether COPCs present unacceptable human health/ecological risk requiring the evaluation of options and technologies to support future actions (e.g., removal, remediation, exposure restriction, migration mitigation or in-place containment); otherwise, consider no further action.
- Confirm the presence or absence of a continuous refusal layer at depth to determine whether future actions (e.g., investigation, delineation, and characterization) are necessary; otherwise, consider no further action.
- Characterize and delineate the refusal layer to determine whether it provides a barrier to downward contaminant migration and whether future actions (e.g., investigation, delineation, and characterization) are necessary; otherwise, consider no further action.
- Characterize and delineate the Lead Additive Area to determine whether COPCs present unacceptable human health/ecological risk requiring the evaluation of options and technologies to support future actions (e.g., removal, remediation, exposure restriction, migration mitigation, or in-place containment); otherwise, consider no further action.
- Determine if vapors have impacted onsite vacant residences on Wilcox and Lorraine Process Areas and the vacant church.
- Determine if asbestos and/or NORM/TENORM are present at the site.
- Determine if wetlands are present at the site.
- Determine if there are risks to human health and/or the environment.

These statements will not be satisfied until all the RI data are available for evaluation.

1.4.4 Step 3 – Identify Information Inputs

Step 3 of the DQO process determines the types and sources of information needed to resolve: (1) the decision statement or produce the desired estimates; (2) whether new data collection is necessary; (3) the information basis the planning team will need for establishing appropriate analysis approaches and performance or acceptance criteria; and (4) whether appropriate sampling and analysis methodology exists to properly measure environmental characteristics for addressing the problem.

The activities in DQO Step 3 are as follows:

- Identify types and sources of information needed to resolve decisions or generate estimates.
- Identify the basis of information that will guide or support choices to be made in later steps of the DQO process.
- Select appropriate sampling and analysis methods for generating the information.

1.4.4.1 Necessary Information and Sources

A variety of sources and types of information form the basis for resolving the decision statements. The following information and sources are necessary to resolve this step of the DQO process.

The decision statements are supported by the information and sources summarized below.

Determine Source of Contamination

- Additional data for all media will be collected as necessary to augment the historical dataset and resolve data gaps; the data will also be adequate to perform risk screening, and if necessary, risk assessment.
- Following review of Mobilization 1 data, collect additional geologic and hydrogeologic information (e.g., borehole geophysics, soil borings, new monitoring wells, pump testing, clay permeability testing, etc.) during Mobilization 2 to evaluate subsurface impacts and potential migration.
- For soil samples, data will be collected to determine background levels for metals and NORM/TENORM for comparison to sample concentrations. For surface water and sediment, data will be collected to define upstream conditions, such that contamination entering the flowing water bodies upstream from the site can be distinguished from site contamination. For ponds not connected to permanent or temporary streams, background concentrations for metals and NORM/TENORM will also be utilized to distinguish from contamination originating onsite.

Determine the Nature and Extent of Contamination

- Soil characterization will be required in areas where ROST LIF survey was performed and in areas not covered by the survey; soil samples will be collected from soil borings and will be analyzed for VOCs, SVOCs (including PAHs), TAL metals, and cyanide. Samples for a smaller set of COPCs (hexavalent chromium, PCBs, pesticides, and dioxin/furans) will be collected from suspect source areas in the Wilcox Process Area, as well as the Lorraine Process Area in the case of hexavalent chromium.
- Surface water and sediment characterization will be required; samples will be analyzed for VOCs, SVOCs (including PAHs), total and dissolved TAL metals, cyanide, and total and dissolved hexavalent chromium; if the extent of contamination is not defined under the initial sampling program, further sampling may be necessary to complete the delineation.
- Initial characterization of ground water will be performed by sampling existing private supply wells. It could not be verified at the time this SAP was written, but the wells are assumed to be extracting water from the regional aquifer; the ground water samples will be analyzed for VOCs, SVOCs (including PAHs), TAL metals, cyanide, and hexavalent chromium. Moreover, information will be collected to ascertain if the water historically called "ground water"—which is believed to be infiltrated water ponding on top of the sandstone/clay layer—is actually water with beneficial uses, and if so, whether it qualifies as a ground water exposure medium and/or is connected with the regional aquifer or surface water. A determination of the depth to the water in the regional aquifer and the potentiometric surface map and ground water gradient will not be accomplished until monitoring wells are installed in this aquifer. Delineation of a ground water impact, if one exists, will be accomplished during a subsequent mobilization.
- Sampling for vapor intrusion will be performed to assess if there is a threat to human receptors using the residences and church investigated.
- Geologic and hydrogeologic information will be collected to evaluate subsurface impacts and potential migration.
- Sampling for biota, should it prove necessary, will be performed to evaluate impacts to ecological receptors.

Determine the Migration Pathways for Contamination

- An evaluation of the migration pathways will be performed for surface runoff outside of source areas
- Surface water transport will be conducted to aid in understanding the transport of contamination via surface water flow and sediment from source areas to the adjacent waterways
- An evaluation of leaching of source material to ground water will be conducted to aid in the understanding of contaminant transport
- An evaluation of ground water migration will be conducted to aid in the understanding of contaminant transport.

Determine if Exposure to COPCs Pose a Potential Unacceptable Risk to Human Health and Ecological Receptors (Appendix B)

- Analytical results for soil, sediment, surface water, vapor intrusion, and ground water samples will be first compared to the screening levels for human health and environmental protection agreed upon during the scoping effort; these values are provided in Appendix B and consist of the following:
  - Soil screening levels:
    - 0.0 - 2.0 ft bgs
      - EPA Regional Screening Levels (RSLs) for human health exposure for residential scenario (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2015) (EPA 2016b)
      - ODEQ risk-based levels for TPH (ODEQ 2012).
    - 0.0 – 10.0 ft bgs
      - EPA RSLs for human health exposure for industrial/construction scenario (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2015) (EPA 2016b)
      - ODEQ risk-based levels for TPH (ODEQ 2012).
    - 0.0 – 0.5 ft bgs: Ecological soil screening levels, ECOTOXicology database (ECOTOX) (http://www.epa.gov/ecotox/ecossl) (EPA 2016a).
  - Ground water screening levels:
    - Federal Maximum Contaminant Levels (MCLs) (https://www.epa.gov/your-drinking-water/table-regulated-drinking-water-contaminants) (EPA 2009b)
    - EPA tap water RSLs (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2015) (EPA 2016b)
    - Oklahoma Water Resources Board (OWRB) Interim Water Quality Standards (WQSs) (https://www.owrb.ok.gov/quality/standards/standards.php) (OWRB 2013)
    - ODEQ risk-based levels for TPH (ODEQ 2012).
  - Surface water:
    - EPA National Water Quality Criteria (https://www.epa.gov/wqc/aquatic-life-ambient-water-quality-criteria) (EPA 1985)
    - OWRB Interim WQSs (https://www.owrb.ok.gov/quality/standards/standards.php) (OWRB 2013).

- Sediment screening levels:
  - Benthic protection based on the National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQuIRT) values listed in (NOAA 2008) (consensus-based unless not available).
  - For comparative purposes only, utilize the Texas Commission on Environmental Quality (TCEQ) Texas Risk Reduction Program (TRRP) Tier 1 Protective Concentration Levels (PCLs) (TCEQ 2014) (https://www.tceq.texas.gov/remediation/trrp/trrppcls.html).
- Air/soil gas screening levels:
  - EPA RSLs for human health exposure in residential and industrial/construction scenarios (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-november-2015) (EPA 2016b)
  - EPA *OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Source to Indoor Air* (EPA 2015a).
- Removal management levels (RMLs):
  - EPA RMLs for use to support the decision to undertake removal action (https://www.epa.gov/risk/regional-removal-management-levels-chemicals-rmls) (EPA 2016c)

- For metals and NORM/TENORM, concentrations in all media will also be compared to the following values:
  - Background values for soil
  - Upgradient concentrations for ground water
  - Upstream concentrations for sediment and surface water.

- If the concentrations exceed the screening levels, a risk assessment will be performed.

Determine Characteristics of Site Waste and Whether It Leached Contaminants to Underlying Soil.

- The waste will be characterized as hazardous or non-hazardous based on the standards in the RCRA, 40 Code of Federal Regulations (CFR) Part 261 (Appendix B).
- Concentrations of soil samples collected from underneath the waste piles will be compared to the standards specified above.

1.4.4.2 Basis of Information

The basis of information will guide or support choices to be made in later steps of the DQO process.

The basis of information is supported by the following:

Determine Source of Contamination

- Biased or judgmental sample locations will be based on evaluation of historical data, photographs, or visual cues.
- Geologic and hydrogeologic information (e.g., soil borings, new monitoring wells, ground water and surface water elevation, etc.) will be collected to evaluate impacts to ground water and the interconnectivity between surface water and ground water.

Determine the Nature and Extent of Contamination

- Biased or judgmental sample locations will be based on evaluation of historical data, photographs, or visual cues.
- Geologic and hydrogeologic information (e.g., soil borings, new monitoring wells, ground water and surface water elevation, etc.) will be collected to evaluate impacts to ground water and the interconnectivity between surface water and ground water.

Determine the Migration Pathways for these Contaminants

- The Interim Final *Guidance for Conducting Remedial Investigations and Feasibility Studies Under Comprehensive Environmental Response, Compensation, and Liability Act* (EPA 1988) describes the process for evaluating migration pathways.

Determine if COPC Exposure Poses a Potential Unacceptable Risk to Human Health and Ecological Receptors

- A HHRA will be conducted in accordance with the EPA's guidance which includes, but is not limited to, the following:
  - *Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual* (EPA 1989)
  - *RAGS for Superfund Volume I: Human Health Evaluation Manual. Supplemental Guidance: Standard Default Exposure Factors* (EPA 1991)
  - *RAGS, Volume I: Human Health Evaluation Manual, Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments* (EPA 2001b)
  - *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites* (EPA 2002c)
  - *RAGS, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)* (EPA 2004)
  - *RAGS, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment)* (EPA 2009a).
- A SLERA will be conducted in accordance with the EPA's guidance which includes, but is not limited to, the following:

- *Ecological RAGS: Process for Designing and Conducting Ecological Risk Assessments, Interim Final* (EPA 1997)
- *Issuance of Final Guidance: Ecological Risk Assessment and Risk Management Principles for Superfund Sites* (EPA 1999b).

To determine the nature and extent of contamination at the site, a field investigation has been proposed to collect multimedia data and resolve data gaps to support the risk assessments and ultimately the FS and ROD for the site. Details pertaining to this effort are presented in Section 2.0 and will not be repeated here for brevity.

Determine the Ultimate Disposition of Site Waste and Whether Further Action is Warranted to Address Underlying Contaminated Soil

- The requirements of RCRA, 40 CFR Part 261, will be followed.
- Soil will be addressed as described above.

1.4.4.3 Sampling and Analysis Methods

An extensive field investigation has been proposed to collect multimedia data. Analyses to be performed on site samples are presented in Appendix B. Details pertaining to this effort are presented in Section 2.0 and will not be repeated here for brevity.

1.4.5 Step 4 – Define the Boundaries of the Study

In Step 4 of the DQO process, the target population of interest and spatial/temporal features pertinent for decision-making should be identified. The activities in DQO Step 4 are as follows:

- Define the target population of interest.

- Specify temporal or spatial boundaries and other practical constraints associated with sample/data collection.

1.4.5.1 Target Population

The target population consists of soil, surface water, sediment, ground water, air, and biota. The following descriptions of the target population are segregated by media below.

Generally soil is not considered mobile because ground cover or vegetation often precludes migration. Mobility of soil due to storm water or particulate migration can lead to a slight temporal aspect to characterization. However, for the purpose of this investigation, soil is not considered to be mobile enough to have a significant temporal aspect. The distribution of soil is from the ground surface to: the bottom of impacted soil, until the water table is encountered, or refusal, whichever is first.

Surface water is mobile with a high temporal aspect in Sand Creek and in East and West Tributaries. Surface water in the ponds located along the temporary creeks is not mobile except under flood conditions and likely has a low temporal aspect. Surface water in the isolated ponds is not mobile and has a low temporal aspect.

Sediment is considered potentially mobile during storm or other high flow events. The fine grain materials are potentially subject to migration and may be transported some distance from the source. Therefore, a minor temporal aspect to the concentration of sediments in a particular location may occur over time. The distribution of sediments is thought to be from several inches to several ft thick in most areas. Typically, sediments contained within the banks of waterways often have higher deposition rates near bends or where surface water flow is reduced.

Limited information is available for ground water. Typically, ground water is found at depths of 30 feet bgs at the Lorraine Process Area to 110 ft bgs in topographically high areas. The ground water gradient at the site is not known, but ground water is assumed to be moving toward Sand Creek.

Soil vapors may have impacted vacant residences located within the process areas and the vacant church at a level that poses a human health risk. A vapor intrusion investigation will be implemented to determine if indoor air has impacted any habitations.

The presence and extent of the waste materials and asbestos present at the site will be defined during the site reconnaissance.

Regarding biota, the media to be sampled have not been decided upon at this time. Generally speaking, plants, soil invertebrates, aquatic organisms in ponds, and benthic organisms are not mobile. Aquatic organisms (unless they are in isolated ponds), mammals, reptiles, and amphibians are considered to have limited mobility. Birds and mammals have high mobility.

1.4.5.2 Spatial Boundaries

Exposure areas are considered to be the site and potentially the sediment and surface water in Sand Creek, its tributaries, and one pond along the East Tributary downstream from the site. This investigation will further evaluate the exposure area and additional areas identified during this investigation, as appropriate. The exposure area may be further subdivided based on the presence of contaminants, potential reuse, available receptors, etc.

1.4.6 Step 5 – Develop the Analytical Approach

Step 5 of the DQO process involves developing an analytical approach that will guide how to analyze the study results and draw conclusions from the data. It is the intention of this step to integrate the outputs from the previous four steps with the parameters developed in this step.

The activities in DQO Step 5 are as follows:

- Specify the appropriate population parameters for making decisions.

- Choose a workable action level and generate an "If … then … else" decision rule which involves it.

1.4.6.1 Population Parameters

The population parameter is defined as the value used in the decision statement to evaluate a decision point. The population parameter will be used as an exposure point concentration in the HHRA and SLERA. A population parameter will be determined for each chemical detected in each exposure area (if unique areas are identified), for each sample group (e.g., surface soil from 0 to 2 ft bgs). Maximum exposure unit concentrations will be used first to determine if a chemical should be kept as a site COPC. If COPCs are identified, the 95% upper confidence limit of the mean (95UCL) will be calculated using ProUCL Version 5.0.0 (EPA 2013c, 2013d) and used in the risk assessments.

For COPCs with detection limits above screening levels, if one-half the lowest Contract-required Quantitation Limit (CRQL) or method reporting limit (RL) for a chemical is greater than its respective screening level, then it will be evaluated in the uncertainty section of the risk assessment (see Section 1.4.3).

In the case of non-detect results, one-half the CRQL or RL will be represented.

1.4.6.2 Action Level Decision Rule

The action levels for the site will likely be either: (1) risk-based screening criteria developed during the HHRA and/or SLERA or (2) federally-mandated ground water criteria such as MCLs.

The risk-based screening criteria for COPCs, as well as background values for soil, upgradient values for ground water, and upstream values for surface water and sediments will be used to evaluate whether the analytical data will have appropriate sensitivity for the risk assessment. Although it is understood that the type of data used to develop the screening criteria may differ from that which will be used in the site-specific risk assessments, these criteria should present conservative values suitable for the initial screening.

Mineral or chemical interference may lead to elevated sample quantitation limits which are greater than their respective risk-based screening levels. If these analytes are not detected in an exposure area and sample quantitation limits are greater than risk-based values, then they may be a source of potential risk underestimation or additional sampling may be conducted to mitigate the uncertainty.

The decision rules for the site are as follows:

- If contamination in soil at a specific source area is above screening levels, perform a risk assessment to determine if the contamination poses an unacceptable risk. If it does pose a risk, determine the most appropriate actions to be taken for risk mitigation during the FS.

- If contamination in surface water and sediment is above screening levels, perform a risk assessment to determine if the contamination poses an unacceptable risk. If it does pose a risk, determine the most appropriate actions to be taken for risk mitigation during the FS.

- If ground water is contaminated is above screening levels, perform a risk assessment to determine if the contamination poses an unacceptable risk. If it does pose a risk, determine the most appropriate actions to be taken for risk mitigation during the FS.

- If vapors are present in shallow soil as indicated by PSG mass in the samplers or if vapors have impacted the residences or the church at a level that poses a human health risk, determine the source of the vapors and implement means of mitigating the intrusion in the future. During the FS, determine the most appropriate actions to be taken for risk mitigation.

- If waste is RCRA hazardous, arrange for disposal at a hazardous waste disposal facility. If it is not RCRA hazardous, arrange for disposal at a non-hazardous waste disposal facility; in the case where no contamination is present in the waste and there is no evidence of leaching to soil, consider leaving the waste onsite. If contamination is present below the waste piles, perform nature and extent characterization following waste removal.

- If the asbestos survey and testing indicates ACM is present at the site, arrange for a specialized contractor to perform a removal of the material.

- If the NORM/TENORM survey indicates these materials are present at the site and pose an unacceptable risk, extend the COPC suite to other media for the site characterization. During the FS, determine the most appropriate actions to be taken for risk mitigation.

- If the wetlands survey confirms that wetlands are present at the site, expand the scope of surface water and sediment sampling to include wetlands characterization. If during risk screening and subsequent risk assessment, it is determined that there is a risk to human health or the environment, determine the most appropriate actions to be taken for risk mitigation during the FS.

Note that some of these decision rules will not be satisfied until data collection is completed during the last mobilization that takes place at the site.

1.4.7 Step 6 – Specify the Performance or Acceptance Criteria

Step 6 of the DQO process specifies the tolerable limits on decision errors. Data are subject to various types of errors (e.g., how samples were collected, how measurements were made, etc.). As a result, estimates or conclusions that are made from the collected data may deviate from what is actually true within the population. Therefore, there is a chance that an erroneous conclusion could be made or that the uncertainty in the estimates will exceed what is acceptable.

The performance or acceptance criteria for collected data will be derived to minimize the possibility of either making erroneous conclusions or failing to keep uncertainty in estimates to within acceptable levels. Performance criteria and QA practices will guide the design of new data collection efforts. Acceptance criteria will guide the design of procedures to acquire and evaluate existing data.

The activities in DQO Step 6 are as follows:

- Recognizing the total study error and devising mitigation techniques to limit error.

- Specify the decision rule as a statistical hypothesis test, examine consequences of making incorrect decisions from the test, and place acceptable limits on the likelihood of making decision errors.

1.4.7.1 Total Study Error

Even though unbiased data collection methods may be used, the resulting data will still be subject to random and systematic errors at different stages of the collection process (e.g., from field sample collection to sample analysis). The combination of these errors is called the "total study error" (or "total variability") associated with the collected data. There can be many contributors to total study error, but there are typically two main components, sampling error and measurement error.

Sampling Error

Sampling error, sometimes called statistical sampling error, is influenced by the inherent variability of the population over space and time, the sample collection design, and the number of samples collected. It is usually impractical to measure the entire population space, and limited sampling may miss some features of the natural variation of the measurement of interest. Sampling design error occurs when the data collection design does not capture the complete variability within the population space, to the extent appropriate for making conclusions. Sampling error can lead to random error (i.e., random variability or imprecision) and systematic error (bias) in estimates of population parameters. In general, sampling error is larger than measurement error and consequently needs a larger proportion of resources to control.

Measurement Error

Sometimes called physical sampling error, measurement error is influenced by imperfections in the measurement and analysis protocols. Random and systematic measurement errors are introduced in the measurement process during physical sample collection, sample handling, sample preparation, sample analysis, data reduction, transmission, and storage.

The potential for measurement error will be mitigated by using accurate measurement techniques. Sampling techniques were selected to limit the measurement error, including the following:

- Sample collection procedures, sample processing, and field sample analysis protocols are standardized and documented in SOPs to ensure that the methodology remains consistent and limits the potential for measurement error.
- Field teams will be trained and will perform specific tasks (e.g., sample collection or processing) throughout the field sampling effort to limit the potential for measurement error.
- Potential for measurement error in the sample analysis will be limited by the analysis of QC samples (e.g., duplicates).
- Data management procedures and sample tracking software (i.e., Scribe) will limit the potential for data reduction, transmission, and storage errors.

1.4.7.2 Statistical Hypothesis Testing and Decision Errors

Decision-making problems are often transformed into one or more statistical hypothesis tests that are applied to the collected data. Data analysts make assumptions on the underlying distribution of the parameters addressed by these hypothesis tests, in order to identify appropriate statistical procedures for performing the chosen statistical tests.

Due to the inherent uncertainty associated with the collected data, the results of statistical hypothesis tests cannot establish with certainty whether a given situation is true. There will be some likelihood that the outcome of the test will lead to an erroneous conclusion (i.e., a decision error).

When a decision needs to be made, there are typically two possible outcomes: either a given situation is true, or it is not. Although it is impossible to know whether an outcome is really true, data are collected and statistical hypothesis testing is performed to make an informed decision. In formulating the statistical hypothesis test, one of the two outcomes is labeled the "baseline condition" and is assumed to represent the *de facto*, true condition going into the test, and the other situation is labeled the "alternative condition." The baseline condition is retained until the information (data) from the sample indicates that it is highly unlikely to be true.

The statistical theory behind hypothesis testing allows for defining the probability of making decision errors. However, by specifying the hypothesis testing procedures during the design phase of the project, the performance or acceptance criteria can be specified.

There are four possible outcomes of a statistical hypothesis test. Two of the four outcomes may lead to no decision error; there is no decision error when the results of the test lead to correctly adopting the true condition, whether it is the baseline or the alternative condition. The remaining two outcomes represent the two possible decision errors. The first is a false rejection decision error, which occurs when the data leads to decision that the baseline condition is false when, in reality, it is true. The second is a false acceptance decision error, which occurs when the data are insufficient to change the belief that the baseline condition is true when, in reality, it is false.

In the statistical language of hypothesis testing, the baseline condition is called the “null hypothesis” (H_o) and the alternative condition is called the “alternative hypothesis” (H_a). A false rejection decision error, or a Type I error, occurs when you reject the null hypothesis when it is actually true. The probability of this error occurring is called alpha (α) and is called the hypothesis test’s level of significance. A false acceptance decision error, or a Type II error, occurs when you fail to reject the null hypothesis when it is actually false. The probability that this error will occur is called beta (β). Frequently, a false rejection decision error is the more severe decision error, and therefore, criteria placed on an acceptable value of alpha (α) are typically more stringent than for beta (β). Statisticians call the probability of rejecting the null hypothesis when it is actually false the statistical power of the hypothesis test. Statistical power is a measure of how likely the collected data will allow you to make the correct conclusion that the alternative condition is true rather than the default baseline condition and is a key concept in determining DQOs for decision-making problems. Note that statistical power represents the probability of “true rejection” (i.e., the opposite of false acceptance) and, therefore, is equal to $1-\beta$.

Decision errors can never be totally eliminated when performing a statistical hypothesis test. However, the primary aim of this step is to arrive at the upper limits on the probabilities of each of these two types of decision errors that the planning team finds acceptable.

1.4.8 Step 7 – Develop the Plan for Obtaining Data

In the Steps 1 through 6 of the DQO process, performance or acceptance criteria were developed. The goal of Step 7 is to develop a resource-effective sampling design for collecting and measuring environmental samples, or for generating other types of information needed to address the PSQs. In addition, this sampling design will lead to data that will achieve the performance and acceptance criteria. The sampling design is detailed in Section 2.

The most important activity in DQO Step 7 is to use the information from Steps 1 through 6 of the DQO process to identify a sampling and analysis design that will answer the PSQs and achieve the performance or acceptance criteria.

The soil, sediment, surface water, and ground water sampling approach incorporates biased or judgmental samples. Samples will be biased toward impacted areas, based on using historical site evidence (e.g., photographic documentation, historical sampling results, etc.) and information obtained during site visit. This does introduce bias and potential sampling error; however, the bias is likely to increase the sample concentration, which will likely result in a more protective remedial decision. Sampling error that is considered more protective of human health or the environment is acceptable for this evaluation.

New data will be combined with the historical dataset to evaluate the nature and extent of contamination in the RI. Data collected during previous site investigations will be considered further during the risk assessment. Only historical data suitable for risk assessment will be combined with the new data to evaluate potential risks for ecological and human health receptors.

1.5 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

A well-defined QA/QC process is integral to the generation of analytical data of known and documented quality. The QC process includes those activities required during data collection to produce data of sufficient quality to support the decisions that will be made based on the data (e.g., decisions to be made prior to, during, and after site removal or remedial actions) (EPA 2006a). After environmental data are collected, QA activities focus on evaluating the quality of the data in order to determine the data usability with respect to support for remedial or enforcement decisions. Table 4 presents the acceptance criteria for definitive onsite and offsite laboratory data for chemical analyses of investigation samples only.

1.5.1 Data Categories

In order to produce data suitable for decision-making, an appropriate analytical technique must be selected. The EPA Superfund program has developed two descriptive categories of analytical techniques: (1) field-based techniques and (2) fixed-laboratory techniques. The type of data generated depends on the qualitative and quantitative DQOs developed for a project. Regardless of whether the data were analyzed utilizing field or laboratory techniques, the data must be of adequate quality for the decision-making process for which the data were collected. For this project, data from both types of techniques will be collected. Section 2 discusses the methods that will be used to analyze the samples. Both field-based and definitive analytical data will be used to support decisions made for this project.

Rigorous analytical methods (e.g., EPA CLP methods or third-party laboratory, if short analytical turnaround time is necessary) are used to generate analyte-specific, definitive data. The definitive quality of the data are assured by: (1) using SOPs and QC processes during data collection; (2) documented control and traceability of reference standards, calibrations, and instrument performance; and (3) acceptable performance of field and laboratory QC procedures within the defined limits established for these procedures.

The majority of the fixed-laboratory analysis for samples collected during the RI sampling event will be conducted by the EPA Region 6 Laboratory and/or an EPA-designated CLP laboratory. Quick Reference Fact Sheets for relevant analytical methods are included in Appendix C. The EA subcontracted commercial laboratory will provide analytical support for analyses that the EPA Region 6 Laboratory and CLP laboratories cannot analyze due to method requirements (e.g., hexavalent chromium), due to schedule requirements, or due to elevated concentrations of contaminants. In addition, a third-party analytical laboratory will be employed to generate data within a short turnaround time. The analytical methods employed will be either EPA-issued or EPA-approved.

1.5.2 Measurement Quality Objectives

The analytical results will be evaluated in accordance with precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters to document the quality of the data and to ensure that the data are of sufficient quality to meet the project objectives. Of these PARCC parameters, precision and accuracy will be evaluated quantitatively by using results of field and laboratory QC check samples.

The sections below describe each of the PARCC parameters and how they will be assessed within this project.

1.5.2.1 Precision

Precision is the degree of mutual agreement between individual measurements of the same property under similar conditions. Usually, combined field and laboratory precision is evaluated by collecting and analyzing field duplicates and then calculating the variance between the samples, typically as a relative percent difference (RPD).

RPD is calculated as follows:

$$\mathrm{RPD} = \frac{|\mathrm{A} - \mathrm{B}|}{(\mathrm{A} + \mathrm{B})/2} \times 100\%$$

where: A = original sample concentration
B = duplicate sample concentration

Field sampling precision is evaluated by analyzing field duplicate samples. For every 10 samples collected, one duplicate sample will be collected.

Laboratory analytical precision is evaluated by analyzing laboratory duplicates (also called matrix duplicates [MDs]) or matrix spikes (MSs) and matrix spike duplicates (MSDs). For this project, MS/MSD and original sample [OS]/MD samples will be generated for analytes. The results of the analysis of each MS/MSD or OS/MD pair will be used to calculate the RPD as a measure of lab precision. In addition, laboratory control samples (LCS) and LCS duplicates are also used for laboratory precision.

1.5.2.2 Accuracy

A program of sample spiking will be conducted to evaluate laboratory accuracy. This program includes analysis of the MS and MSD samples, LCSs or blank spikes, surrogate standards, and method blanks. MS and MSD samples will be prepared and analyzed at a frequency of 5 percent for project samples. LCSs or blank spikes will also be analyzed at a frequency of 5 percent or one per batch. Surrogate standards, where applicable, are added to every sample analyzed for organic constituents. The results of the spiked samples are used to calculate the percent recovery for evaluating accuracy.

$$\text{Percent Recovery} = \frac{S - C}{T} \times 100\%$$

where: S = measured spike sample concentration
C = sample concentration
T = true or actual concentration of the spike

The objective for accuracy of field measurements is to achieve and maintain factory specifications for the field equipment.

1.5.2.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent the characteristics of a population, variations in a parameter at a sampling point, or an environmental condition that they are intended to represent. For this project, representative data will be obtained through careful selection of sampling locations and analytical parameters. Representative data will also be obtained through proper collection and handling of samples to avoid interference and minimize contamination.

Representativeness of data will also be ensured through the consistent application of established field and laboratory procedures. Field blanks (if appropriate) and laboratory blank samples will be evaluated for the presence of contaminants to aid in evaluating the representativeness of sample results. Data determined to be non-representative, by comparison with existing data, will be used only if accompanied by appropriate qualifiers and limits of uncertainty.

1.5.2.4 Completeness

Completeness is a measure of the percentage of project-specific data that are valid. Valid data are obtained when samples are collected and analyzed in accordance with QC procedures outlined in this SAP, and when the QC criteria that affect data usability are not grossly exceeded. When data validation is completed, the percent completeness value will be calculated by dividing the number of useable sample results by the total number of sample results planned for this investigation.

Completeness will also be evaluated as part of the data quality assessment (DQA) process (EPA 2006c, 2006d). This evaluation will help determine whether limitations are associated with the decisions to be made based on the data collected.

1.5.2.5 Comparability

Comparability expresses the confidence with which one data set can be compared with another. Comparability of data will be achieved by consistently following standard field and laboratory procedures and by using standard measurement units in reporting analytical data. Standard EPA analytical methods and QC will be used to support the comparability of analytical results with those obtained in previous testing. Calibrations will be performed in accordance with EPA or manufacturer's specifications and will be checked with the frequency specified in the EPA CLP SOW(s) or applicable methods.

1.5.3 Detection and Quantitation Limits

The analytical parameters and their quantitation limits for use on this project are determined under the EPA CLP SOW(s) or applicable method. The Contract-required Detection Limit (CRDL), for CLP methods, or Method Detection Limit (MDL), for non-CLP methods, is the minimum concentration of an analyte that can be reliably distinguished from background noise for a specific analytical method. The quantitation limit represents the lowest concentration of an analyte that can be accurately and reproducibly quantified in a sample matrix. The CRQL, for CLP methods, or RL for non-CLP methods, is the contractually specified maximum quantitation limit for specific analytical methods and sample matrices, such as soil or water, and are typically several times the CRDL or MDL, to allow for matrix effects. Quantitation limits for non-CLP methods are typically referred to as the method RL.

For this project, analytical methods have been selected so that the CRQL or RL for each target analyte is below the applicable screening criteria, wherever practical. Samples results will be reported as estimated values if concentrations are less than the CRQL/RL but greater than CRDL/MDL. The CRDL or MDL for each analyte will be listed as the detection limit in the laboratory's electronic data deliverable (EDD).

Laboratory analysis methods were selected to obtain the lowest CRQLs and RLs. Data collected during the RI will undergo an evaluation of the CRQLs and RLs in conjunction with screening criteria to ensure that the data are adequate.

- If one-half the lowest CRQL or RL for a chemical is greater than its respective screening level, then it will be evaluated in the uncertainty section of the risk assessment.

- If a chemical is reported in a field sample and in a method blank or field blank, it will be considered as a positive identification if the field sample concentration is present at a concentration greater than 10 times the maximum blank concentration for common laboratory contaminants or 5 times the maximum blank concentration for other analytes. Common laboratory contaminants include acetone, methylene chloride, methyl ethyl ketone, phthalate esters, and toluene.

- Data with "estimated" qualifiers (e.g., J-qualifier) will be considered detected concentrations.

1.6 SPECIAL TRAINING AND CERTIFICATION

This section outlines the training and certification required to complete the activities described in this SAP. The following sections describe the requirements for the EA team and subcontractor personnel working onsite.

1.6.1 Health and Safety Training

EA field team personnel who work at hazardous waste project sites are required to meet the Occupational Safety and Health Administration (OSHA) training requirements defined in 29 CFR 1910.120(e). These requirements include: (1) 40 hours of formal offsite instruction; (2) a minimum of 3 days of actual onsite field experience under the supervision of a trained and experienced field supervisor; and (3) 8 hours of annual refresher training. Field personnel who directly supervise employees engaged in hazardous waste operations also receive at least 8 additional hours of specialized supervisor training.

Copies of the field team's health and safety training records, including course completion certifications for the initial health and safety training, refresher training, and specialized supervisor training are maintained in project files.

Additional health and safety details can be found in EA's site-specific HSP (EA 2016).

1.6.2 Subcontractor Health and Safety Training

Subcontractors who work onsite will certify that their employees have been trained for work on hazardous waste project sites. Training will meet OSHA requirements defined in 29 CFR 1910.120(e). In addition, the asbestos and NORM/TENORM surveys will be performed by specialized contractors that will hold the training and certification necessary to do that work. Subcontractors will attend a safety briefing and complete the Safety Meeting Sign-Off Sheet before they conduct onsite work (EA 2016). This briefing is conducted by the EA Site Health and Safety Officer or other qualified person. Alternatively, the subcontractors may elect to conduct their own safety briefings; EA personnel may audit these briefings.

Before work begins at the project site, subcontractors will submit copies of the training certification for each employee assigned to the project. Copies of the subcontractor's health and safety training records will be maintained in project files.

1.7 DOCUMENTS AND RECORDS

The following sections discuss the requirements for documenting field activities and for preparing laboratory data packages. This section also describes reports that will be generated as a result of this project.

1.7.1 Field Documentation

Field personnel will use permanently bound field logbooks with sequentially numbered pages to record and document field activities and will follow EA SOP 016 (Appendix G) for completing field logbooks. The logbook will list the contract name and number, the site name, and names of subcontractors, service client, and EA Project Manager. At a minimum, the following information will be recorded in the field logbook:

- Name and affiliation of onsite personnel or visitors
- Weather conditions during the field activity
- Other non-weather-related conditions at the time of sampling
- Summary of daily activities and significant events
- Notes of conversations with coordinating officials
- References to other field logbooks or forms that contain specific information
- Discussions of problems encountered and their resolution
- Discussions of deviations from the SAP or other governing documents
- Description of photographs taken
- Specific volumes of materials used to plug holes, wells, etc.
- GPS data.

1.7.2 Laboratory Documentation

This section describes the data reporting requirements for EA field personnel and laboratories (e.g., EPA CLP laboratories, EPA Region 6 Laboratory, or subcontracted commercial laboratories) that submit field and laboratory measurement data under the EPA Region 6 RAC II program.

EA will require fixed offsite, subcontracted private commercial laboratories to prepare and submit data packages in accordance with the EPA CLP protocols (EPA 2014d, 2015c, 2015d) for hardcopy and EDD format of data. Data packages will include applicable documentation for independent validation of data and verification of the DQOs. The following documentation will be required for full data validation, if applicable:

- Case narratives, which will describe QC non-conformances that are encountered during the analysis of samples in addition to corrective actions that are taken:
  - Statement of samples received
  - Description of deviations from the specified analytical method
  - Explanations of data qualifiers that are applied to the data
  - Other significant problems that were encountered.

- Tables that cross-reference field and laboratory sample numbers.

- Chain-of-custody forms, which pertain to each sample delivery group or sample batch that is analyzed.

- Laboratory reports, which must show traceability to the sample analyzed and must contain specified information:
  - Project identification
  - Field sample number
  - Laboratory sample number
  - Sample matrix description

- Dates and times of sample collection, receipt at the laboratory, preparation, and analysis
- Description of analytical method and reference citation
- Results of individual parameters, with concentration units, including second column results, second detector results, and other confirmatory results, where appropriate
- Quantitation limits achieved
- Dilution or concentration factors.

- Data summary forms and QC summary forms showing analytical results, if applicable:
  - Samples
  - Surrogates
  - Blanks
  - Field QC samples
  - LCS
  - Initial and continuing calibrations
  - Other QC samples.

- Laboratory control charts:
  - Raw data
  - Instrument printouts
  - Laboratory bench sheets for preparation of samples.

- MDL study results.

EA's Project Manager, in cooperation with the EA QA Officer, will define site-specific requirements for data reporting. Requests for analytical services define these requirements, the turnaround time for receipt of the data deliverables specified, and requirements for retaining samples and laboratory records. Laboratory QA Managers are responsible for ensuring that laboratory data reporting requirements in this SAP are met.

1.7.3 EPA Level IV Type Data Package

The laboratory will prepare EPA Level IV type data packages in accordance with the instructions provided in the EPA CLP SOWs (EPA 2014d, 2015c, 2015d). Commercial laboratories conducting non-CLP analyses will be required to prepare Level IV type data packages. The data packages will contain the information from the summary data package and associated raw data and are due to EA within 35 days after the last sample in the sample delivery group is received. Unless otherwise requested, the laboratory will deliver one copy of the Level IV type data package.

1.7.4 Reports Generated

Following the completion of the RI field program and receipt of validated data, the following reports associated with the site RI will be completed:

- Data Evaluation Summary Report (DESR)
- RI Report, including SLERA and HHRA Reports.

The DESR, prepared upon receipt of all RI analytical data, will (1) compile, tabulate, and summarize the analytical data; (2) discuss the usability of the data, including data validation summaries; and (3) discuss any discrepancies or data quality issues.

The RI Report will provide information to assess risks to human health and the environment, and to support the development, evaluation, and selection of appropriate response alternatives. The RI Report will be written in accordance with EPA's *Guidance for Conducting Remedial Investigations/Feasibility Studies under the Comprehensive Environmental Response, Compensation, and Liability Act* (EPA 1988) and *Guidance for Data Usability in Risk Assessment* (EPA 1992a and 1992b).

Typical components of the RI Report include, but are not limited to, the following:

- Site Background
  - Site description
  - Site history
  - Previous investigations summary

- Investigation
  - CSM
  - Field investigation and technical approach
  - Chemical analyses and analytical methods
  - Field methodologies (e.g., soil gas sampling and sub-slab sampling)
  - Deviations from the SAP with explanation on impact to DQOs

- Site Characteristics
  - Geology
  - Hydrogeology
  - Demographics and land use

- Nature and Extent of Contamination
  - Contaminant sources
  - Summary of analytical results
  - Contaminant distribution and trends

- Fate and Transport
  - Contaminant characteristics
  - Degradation pathways

- — Transport processes
- — Contaminant migration trends

- Summary of the HHRA and SLERA.

- Summary and Conclusions.

2. DATA GENERATION AND ACQUISITION

This section describes the requirements for the following:

- Sampling process design
- Consent for property access
- Sampling methodology
- Sample processing
- Decontamination
- Management of investigation-derived waste (IDW)
- Sample designation
- Sample container, volume, preservation, and holding time requirements
- Sample handling and custody
- Analytical method requirements
- QC requirements
- Instrument calibration and frequency
- Requirements for inspection and acceptance of supplies and consumables
- Data acquisition requirements
- Data management.

2.1 SAMPLING PROCESS DESIGN

For the activities associated with this SAP, main elements of the sampling design include the numbers and types of samples to be collected, sampling locations, sampling frequencies, and sample matrices as appropriate to fill data gaps, define potential plumes and hot spots, and collect data as necessary to support ongoing evaluations of risk at the Site.

As stated in the DQOs (Section 1.3), the following PSQs were formulated for the RI field program (Mobilizations 1 through 3):

- Are waste piles Resource Conservation and Recovery Act (RCRA) hazardous or non-hazardous and have contaminants leached from the waste into the underlying soil layer?
- What is the nature of contamination in soil within specific source areas and what is the extent of contamination?
- What is the nature of contamination in surface water and sediment and what is the extent?
- What is the extent and volume of contaminated media in the Lead Additive Area?
- Is there a ground water aquifer at the site, and if present what is the classification and what is the nature and extent of contamination?
- Is there LNAPL present and what is the extent and volume?
- Is the refusal layer continuous across the site and does it provide a barrier to downward contaminant migration?

- Is vapor intrusion an issue at select properties?
- What are the migration pathways for transport of these contaminants in different media?
- Are asbestos and/or NORM/TENORM present at the site?
- Are wetlands present at the site?
- Is there a risk to human health or the environment from contamination at the site?

The primary objective of the sampling design is to collect data of sufficient quantity and quality to resolve the PSQs and support risk assessment and remedy evaluation. The purpose of the RI is to determine the nature and extent of contamination and to gather sufficient information so that the EPA can select a remedy that eliminates, reduces, or controls risks to human health or the environment. This can be accomplished by answering the PSQs as follows:

- Delineate and characterize waste piles and underlying soil.
- Determine if ROST LIF data are adequate to characterize the nature and extent of contamination in surface and subsurface soil and use that information to continue delineation of contamination and soil sampling.
- Characterize and delineate soil contamination at specific source areas.
- Characterize and delineate contamination in surface water and sediment.
- Characterize and delineate contamination to determine how and what future actions (e.g., investigation, delineation, characterization) are necessary to characterize the ground water; otherwise, consider no further action.
- Characterize and delineate contamination in ground water to determine whether COPCs present unacceptable human health/ecological risk requiring the evaluation of options and technologies to support future actions (e.g., removal, remediation, exposure restriction, migration mitigation, or in-place containment); otherwise, consider no further action.
- Confirm the presence or absence of ground water contamination discharge to the surface water to determine how and what future actions (e.g., investigation, delineation, characterization) are necessary to characterize this interaction; otherwise, consider no further action.
- Characterize and delineate ground water discharge to surface water to determine whether COPCs present unacceptable human health/ecological risk requiring the evaluation of options and technologies to support future actions (e.g., removal, remediation, exposure restriction, migration mitigation, or in-place containment); otherwise, consider no further action.
- Confirm the presence or absence of LNAPL to determine whether future actions (e.g., removal, remediation, exposure restriction, migration mitigation, or in-place containment) are necessary; otherwise, consider no further action.

- Characterize and delineate the LNAPL to determine whether COPCs present unacceptable human health/ecological risk requiring the evaluation of options and technologies to support future actions (e.g., removal, remediation, exposure restriction, migration mitigation or in-place containment); otherwise, consider no further action.
- Confirm the presence or absence of a continuous refusal layer at depth to determine whether future actions (e.g., investigation, delineation, and characterization) are necessary; otherwise, consider no further action.
- Characterize and delineate the refusal layer to determine whether it provides a barrier to downward contaminant migration and whether future actions (e.g., investigation, delineation, and characterization) are necessary; otherwise, consider no further action.
- Characterize and delineate the Lead Additive Area to determine whether COPCs present unacceptable human health/ecological risk requiring the evaluation of options and technologies to support future actions (e.g., removal, remediation, exposure restriction, migration mitigation, or in-place containment); otherwise, consider no further action.
- Determine if vapors have impacted onsite vacant residences and the vacant church within process areas.
- Determine if asbestos and/or NORM/TENORM are present at the site.
- Determine if wetlands are present at the site.
- Determine if there are risks to human health and/or the environment.

The goal is to collect the appropriate amount of data necessary to result in a well-supported FS and ROD. To achieve this goal, site media will be sampled during the RI.

2.2 ANALYSES

Multimedia samples will be collected for laboratory analysis using a host of field methods. Table 5 lists the SOPs that will be implemented during the field program at the direction of EPA. Tables 6 through 9 summarize the type and quantities of soil, surface water, sediment, ground water, and air samples that are planned for collection during the RI field program. Due to a number of uncertainties at this point in the RI, contingency samples are also specified for the sampling of various media. Rationale for analyses is discussed below.

As discussed in Section 1.3.2, the list of COPCs at the site will be initially applied conservatively to all media across the investigation, as relatively extensive rework of the site ground surface has taken place in several locations, thus removing historical site features. For these reasons, the full set of COPCs cannot be refined until source characterization has been completed. The exception to this approach is analysis for NORM/TENORM. Media samples will not be analyzed for these compounds until Mobilization 2, when this analysis will be added appropriately to samples for various media to be collected in the areas where the survey indicates the presence of these materials.

Table 10 summarizes the proposed analytical suites for each media and/or sample type during Mobilization 1.

Soil, sediment, ground water, and surface water samples will undergo the following analyses:

- VOCs
- EDB (only in water samples, if not included at an appropriately low detection limit in the VOC analysis)
- SVOCs (including PAHs)
- TAL metals (surface water samples will be analyzed for both total and dissolved TAL metals)
- Cyanide.

A subset of soil, sediment, ground water, and surface water samples associated with the former cooling tower/cooling pond areas will be analyzed for hexavalent chromium.

A subset of shallow surface soil samples (0.0–0.5 ft bgs) associated with the Wilcox Process Area will undergo the following analyses:

- PCBs
- Pesticides
- Dioxins/furans.

PSG, indoor air, and active soil gas samples will undergo the following analyses:

- BTEX
- Napthalene

In addition, PSG samples will also be analyzed for 2-Methylnaphthalene.

Suspected ACM will be analyzed for the presence of asbestos.

The following additional testing will be performed:

- Ground water (all field parameters)
  - Temperature
  - pH
  - Conductivity
  - Oxidation-reduction potential (ORP)
  - Dissolved oxygen (DO)
  - Turbidity.

- Surface water
  - Dissolved metals
  - Hardness
  - Total dissolved solids (TDS)
  - Total suspended sediment
  - Alkalinity
  - Total organic carbon
  - Field parameters, including temperature, pH, conductivity, ORP, and DO.

- Sediment samples
  - Acid volatile sulfide (AVS)
  - Simultaneous extracted metals (SEM)
  - Grain size (20 percent of samples)
  - Total organic carbon
  - pH

IDW samples will undergo the following analyses:

- Toxicity Characteristic Leaching Procedure (TCLP) VOCs
- TCLP SVOCs
- TCLP metals
- TPH
- Reactivity, corrosivity, and ignitability.

2.3 SAMPLING METHODOLOGY (MOBILIZATION 1)

This section describes the procedures for sample collection during Mobilization 1. Table 5 lists the SOPs that will be implemented during the field program at the direction of EPA. The SOPs are provided in Appendix G.

Sample collection and handling procedures will follow CLP protocols in accordance with EPA's *Contract Laboratory Program Guidance for Field Samplers* (EPA 2014c).

During sample collection, preparation, and field analysis, chain of custody will be maintained and documented as required in Section 2.9. Sample locations will be delineated using GPS, be documented photographically, and sketched in the field logbook; an accompanying photograph log will be completed in the field logbook (Section 1.6.1).

2.3.1 Utilities, Access Agreements, and Permits

Prior to performing intrusive Mobilization 1 field activities, Oklahoma One Call will be contacted to locate all public underground utilities and a private utility locate company will be contracted to locate utilities on private property.

EPA will obtain consent for property access agreements from the private property owners that have been identified for investigation under the RI/FS. For properties where the property owner cannot be identified and/or the property owner is not responsive, other properties may be identified for characterization, as appropriate.

The driller will be responsible for completing all permits associated with installation and plugging of monitoring wells and/or boreholes with the Oklahoma Water Resource Board.

2.3.2 Site Preparation

EA will mobilize to the site and set up temporary field offices within the church parking area (within the boundary of the Lorraine Process Area) to establish a command post for the field phase of the investigation.

While setting up the command post, clearing and chipping will be conducted in the Wilcox Process Area and the southern portion of the Lorraine Process Area. Shrubs and trees (less than 6 inches in diameter) will be cleared and chipped in place. It is estimated that up to 20 acres of land will require clearing. Other areas will be cleared, as needed, for access during site reconnaissance and waste delineation, including the North Tank Farm and Loading Dock Area.

2.3.3 Site Reconnaissance and Surveys

Prior to performing intrusive activities, a site reconnaissance will be conducted in preparation for the sampling program. Several surveys—including an ACM survey, wetlands survey, and NORM/TENORM survey—will also be conducted at this time, as well as the passive soil gas investigation by EPA ERT.

2.3.3.1 Site Reconnaissance

The following site reconnaissance activities will be conducted concurrent with site preparation activities:

- Assess former locations of unconfirmed Tanks 1 and 4 – Based on aerial photography, two areas to the east of the East Tributary have been cleared of vegetation. There is no evidence that these areas have ever been used for industrial operations. The two areas will be visited during the site reconnaissance and any indication of presence of discolored soil, distressed vegetation, and/or the presence of any equipment will be recorded and locations delineated with GPS. Also, access for sampling will be assessed and clearing of an access route will take place, if needed.

- Locate Seeps – Assist ODEQ in using a thermal infrared imaging camera to determine the location of the seeps and locations where runoff from the site drains into Sand Creek and the East and West Tributaries (PPEs), and delineate using GPS. This information will be used to determine the potential locations for surface water/sediment sampling in order to optimize the sampling strategy and eliminate duplication of effort.

- Assess Bridge Area – Coordinate with ODOT to (1) visually assess the Sand Creek bridge that was constructed using onsite borrow material; and (2) select possible locations for sediment sampling (no actual sample collection is planned during the site reconnaissance). Potential sample areas will be delineated using GPS.

- Assess Background Area – Reconnoiter the large field across Refinery Road from the East Tank Farm (just north of former Tank 5 location), which is currently proposed for soil background sampling, and assess if this area has evidence of anthropogenic activities; if so, confirm location is adequate for background sampling; if not, select another location.

- Residential Well Assessment – Determine how many residences have private water wells and determine if access has been granted; if not, obtain consent to sample their wells in coordination with ODEQ. Determine if the residents have any information on how the wells were constructed (depth of well, borehole log, screen interval, etc.); research if there is a state or local repository for drilling information.

- Private Wells Not In Use – There are three inactive wells (not in use): the church well located at the Lorraine Process Area, and two wells located on the East Tank Farm. Locate, determine if pumps are present, and, if possible, gauge the wells using a water level indicator and/or interface probe.

- Additional Waste Piles – Identify additional waste piles and areas of exposed waste material. Delineate the waste piles using GPS and visually assess how many types of waste may be present in each pile.

- Map Outcrops – An overburden thickness isopach map has been created during previous investigations; however, the Northern Tank Farm area was not included. Sandstone outcrops will be mapped in the Northern Tank Farm area to aid in determining overburden thickness in this area.

2.3.3.2 Site Surveys

In conjunction with site reconnaissance activities, wetlands, ACM, and NORM/TENORM surveys will be conducted.

<u>Wetlands Survey</u>

The HRS Documentation Record (EPA 2013a) notes the presence of wetlands associated with the site. The presence of the wetlands will be first confirmed per the protocol described below. If wetlands are identified, then this sensitive environment will be included in the CSM and additional characterization and sampling may be required.

The wetlands survey will be performed during the site reconnaissance. The following protocol will be applied:

1. Obtain and review available Natural Resource Conservation Service soil surveys, infrared and true color aerial imagery, National Wetland Inventory (NWI) data. Based on this data, preliminarily identify locations with hydric soil and potential hydric soil, areas identified as wetlands by NWI, and possible wetland signatures on infrared imagery.

2. Ground-truth wetland extents in accordance with the U.S. Army Corps of Engineers (USACE) *Wetland Delineation Manual* (1987) and *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region (Version 2.0)* (2010). Wetlands will be delineated based on the following three criteria:

    a. Indicators of hydrology
    b. Dominant hydrophytic vegetation in the appropriate stratum
    c. The presence of hydric soil.

    Delineation will be performed by walking along the wetland-upland interface and continually identifying the interface where these three criteria are met and not met. At each point where the line changes direction, the interface will be marked with colored surveyor flagging tape and pin flags, as appropriate. Additionally, flags and tape will also be set in a way as to capture the wetland areas, as well as so that each flagged location is visible from the next flag on each line in both directions. A Wetland Determination Data Form (Great Plains Region) will be populated at each location where the vegetative community or soil type changes along the wetland delineation. Each flag will be marked with a discrete identification number. Vegetative community boundaries will be identified, sketched, and recorded. Wetland community boundaries that border each other will be approximated and not delineated.

A GPS unit will be used to record the flagged locations. The GPS unit will be capable of locating each flagged location with sub-meter accuracy.

ACM Survey

An asbestos survey will be performed by a certified contractor during the site reconnaissance. During the asbestos survey, the contractor will identify potential asbestos locations and these locations will be sampled. If collected, the samples will be analyzed via Phase Contrast Microscopy and Polarized Light Microscopy.

NORM/TENORM Survey

Field screening activities for identification of NORM/TENORM will consist of using field instruments and detectors to identify the possible presence and degree of NORM/TENORM in remaining production equipment or tanks, pits, ponds, or temporary water storage areas. A walkover survey with gamma-detecting instruments will be performed around the site with an objective of surveying areas that may have been impacted by crude oil operations and water/wastewater storage. An area at or near the site thought to be non-impacted will be surveyed for use as a reference background area. Direct-read alpha/beta radiological instruments will be used throughout the field operations of the project for scanning and surveying of personnel, equipment, and materials to quantify the total surface radioactivity levels. If elevated alpha/beta readings are observed, smear samples will be collected and counted to quantify the removable radioactivity levels. Measurement results (total and removable) will be compared to the Acceptable Surface Contamination Levels presented in Oklahoma General Radiation Control Regulations (Oklahoma Administrative Code 2014 and Association of State and Territorial Solid Waste Management Officials 2014) or concentration-based standards for soil and water. No NORM/TENORM-specific regulations exist in Oklahoma; therefore, NORM/TENORM are subject to the general radiation control regulations stated above.

Table 11 lists the proposed instruments, detectors, and equipment (or their equivalent) to be used onsite during field screening for NORM/TENORM.

If the field screening indicates that NORM/TENORM are present, then a subset of the waste, shallow surface soil, surface water, and sediment samples will be analyzed for NORM/TENORM.

2.3.3.3 Passive Soil Gas Survey

EPA ERT has been tasked with conducting passive soil gas (PSG) survey in an effort to delineate the vadose zone source area in accordance with SOPs 003, and 027A (Appendix G). PSG samplers will be deployed at depths ranging between 12 and 30 inches bgs, as specified by the soil gas vendor selected. The soil gas samplers will be judgmentally deployed based on a 50-ft-square grid system depending on location onsite. Figures 5, 6, and 7 present the proposed deployment layout. Sample borings will be advanced with a hammer drill equipped with a 0.75-inch diameter bit. The boring will be advanced to the desired depth and the PSG sampler will be lowered into the hole attached to a retrieval wire. A pin flag will also be placed at each location (if possible), and the boring covered. After a minimum of seven days, the soil gas samplers will be located using the pin flag and the sample will be retrieved by pulling the retrieval wire; the samplers will be placed into the sample container provided by the contracted soil gas vendor. The soil gas sampler locations will be surveyed using a hand-held GPS unit. GPS data attributes for each PSG sample position will be logged and include:

- Latitude and longitude
- Collector name
- Collection method
- Datum
- Maximum Positional Dilution of Precision
- Date and time.

PSG samplers will be submitted to the subcontracted vendor for analysis for BTEX, naphthalene, and 2-methylnaphthalene using SW-846 Method 8260C Modified (or equivalent method).

2.3.4 Soil Exposure Media Investigation

Soil sampling during Mobilization 1 will be performed to (1) horizontally and vertically delineate outer boundary of contaminated areas as defined during the December 2015 ROST LIF investigation; (2) collect samples for analysis of the full COPC suite in areas where a ROST LIF survey has left data gaps or was not performed or in areas where source areas may have been located at the Lorraine and Wilcox Process Areas; (3) collect soil samples between suspected source areas and Sand Creek to evaluate subsurface migration to surface water; and (4) perform an initial assessment of former locations of Tanks 1 and 4 (located on the east side of East Tributary. Each of these goals of the soil investigation is discussed in the sections below. Additional detail on the sampling program is provided in Table 6 and the sample locations are shown on Figures 8 through 10.

In general terms, the usability of the soil samples is as follows, depending on the depth of collection:

- 0.0–0.5 ft bgs – ecological risk assessment
- 0.0–2.0 ft bgs – residential scenario
- 0.0–10.0 ft bgs – construction, trespasser, and future residential scenarios
- >10.0 ft bgs – delineation/nature & extent of contamination and migration to ground water.

For clarity and to avoid repetition, the soil sampling techniques are only presented in Table 6. All soil samples will be described, screened, and homogenized (aliquots for non-volatile analysis only) as described in the following sections.

Following completion of sampling activities, soil borings will be abandoned in accordance with SOP 028 (Appendix G).

2.3.4.1 Soil Sample Collection Methods

Several methods of obtaining soil samples from the surface and subsurface are discussed below.

<u>Hollow-stem Auger (HSA) Drilling and Sample Collection</u>

Drilling using a HSA rig is proposed due to the advantage it affords in collection of sample material from the horizon where refusal has been encountered during previous investigations where cone penetrometer testing and direct-push technology (DPT) were attempted at the site. Drilling will be performed by a licensed driller. Borings will be sampled continuously using split spoons or continuous sampling device that is decontaminated between uses.

<u>DPT and Sample Collection</u>

A track-mounted DPT rig will be used in areas where access is difficult. This DPT rig will also be used for expediency in areas where sampling is to be performed at shallower depths and a characterization of the refusal horizon is not critical. DPT will be performed by a licensed driller. Continuous soil cores will be collected using clear polyvinyl chloride or acetate sleeves.

Sample Collection Using Hand-operated (Manual) Equipment

Hand-operated or manual soil sampling equipment will be implemented in areas where access to the track-mounted DPT rig is not possible, such as at former locations of Tanks 1 and 4. EA personnel will collect soil samples with a hand-held slide hammer, or other similar hand-held sampling device.

2.3.4.2 Lithological Logging and Field Screening

A field geologist will log the material types within each core to assist in the understanding of site geology and for the nature and extent evaluation. Soil borings will be logged on standard boring log forms (Appendix D) using the Unified Soil Classification System methodology. During logging the field team will also screen the samples using a photoionization detector, make olfactory and visual observations, and record this data on the boring log form.

2.3.4.3 Sample Material Homogenization

Regardless of the method of collection, the soil sample material will be collected across the entire sampling interval specified in the SAP. Following collection of the aliquot for VOC analysis, the remaining sample material will be homogenized for collection of the remaining sample aliquots. The aliquot for VOC analysis will be collected from the sample material or core with as little disturbance as possible, and will be from a depth no shallower than 2 inches bgs. VOC sample aliquots will be collected directly from the sample material or soil core using En Core™ samplers or other single-use samplers in accordance with EPA SW-846 Method 5035/5035A.

2.3.4.4 Delineation of the ROST LIF Boundaries and Delineation of Nature and Extent

Existing data for soil was reviewed prior to initiating data collection for the RI; however, none of the former samples were analyzed for the entire suite of COPCs and, in some cases, analytical methods used for PAH analysis either did not have low enough detection limits (such is the case with some of the 1999 samples) or samples were analyzed for PAHs at elevated detection limits due to matrix interference (high concentration samples). As such, a comparison to screening levels could not be completed. The ROST LIF data and the historical sample analysis results were used to guide the initiation of the sampling at each source area to optimize the characterization process. The following data will be collected during the RI to provide input into the decision process:

1. Sample locations and depths will be selected for collection from representative intervals determined based on the results of the ROST LIF screening data, in order to characterize and delineate the outer boundary of source areas identified by the ROST LIF data.

2. The total depth of the boring will be the depth of refusal or encountering bedrock or ground water. Soil borings will be installed using either a DPT or HSA rig at the locations indicated on Figures 8, 9, and 10.

3. Samples will be collected from the following depths:
    a. 0.0–0.5 ft bgs
    b. 0.5–2.0 ft bgs
    c. 2.0–6.0 ft bgs
    d. 6.0–10.0 ft bgs
    e. Total depth of the boring (the sample will span 2 ft measured up from the bottom of the boring above refusal).
4. Soil samples will be analyzed by a fixed laboratory for the suite of analytes presented in Table 6.

Due to the fact that many of the site COPCs cannot be detected with the ROST LIF technology, the main goal of this comparison is to determine if the ROST LIF data can be used as an indicator for the preponderant paths of migration for contaminants may be in the areas screened in 2015, thus providing useful information in the placement of the new soil borings for collection of soil samples; however, no actual correlations will be drawn between the chemical and ROST LIF data, because it has been observed that the compounds that are detected by the ROST LIF technology do not seem to have migrated in a uniform manner through the subsurface. The focus will be placed on locations that show no detections with the ROST LIF technology, as they will be critical in the delineation of the lateral and vertical extent of the contamination. In some places, contamination is more prevalent in the shallow horizons, while in other cases, it has moved through the entire column of unconsolidated soil and is present on the surface where the DPT technique reached refusal. It is also upon this refusal surface that infiltrated water has been ponding. The infiltrated water is transient in nature and is the result of precipitation events at the site; it is not, however, considered to be ground water exposure medium, as it has no beneficial uses (cannot yield sufficient water for any prolonged use) and as such, concentrations in this water cannot be compared to human health-based standards. This water will be considered a transport medium for the contamination away from the point of infiltration.

If the usability of the ROST LIF data is confirmed as an indicator as described above, additional soil borings will be installed to collect data for both delineation of nature and extent of contamination and risk assessment. These data will collected as described above. Points where lead concentrations were indicated to be potentially high based on based on XRF screening results were also added to this sampling program.

After the delineation of contamination is performed as described above around the source areas during Mobilization 1, the data will be evaluated for any remaining data gaps. Based on Mobilization 1 data, additional soil sampling may be performed for risk evaluation under the residential scenario using ICS methodology during Mobilization 2, for which DQOs will be formulated.

2.3.4.5 Characterization of the Former Cooling Tower/Pond Areas

The former cooling towers and cooling ponds are associated with historical refining activities at Lorraine and Wilcox Process Areas (Figure 3). Borings will be installed for the characterization of these source areas as shown on Figures 8 and 9. Hexavalent chromium is an additional COPC for these sources area and it has been added to the analytical suite for these samples. The sampling program is presented in Table 6.

2.3.4.6 Initial Assessment at Former Locations for Tanks 1 and 4

Surface soil sampling is proposed at these two former tank locations if, during the reconnaissance, evidence is found that industrial activities have taken place. Judgmental sampling will first address any locations identified during reconnaissance that have the potential to be contaminated, or if present, around remaining equipment. If no evidence of anthropogenic activities besides clearing is observed, sampling will consist of collecting soil samples from 0.0–0.5 ft bgs and 0.5–2.0 ft bgs from five locations within each source area. Proposed sample locations are presented on Figure 10 and are shown on Table 6.

2.3.4.7 Soil Sampling for Delineation of Lead Impact

EPA Headquarters has been tasked with XRF delineation of the Lead Additive Area using ICS methodology, and as such, they will generate a task-specific SAP separate from this submittal. EA will assist EPA Headquarters representatives during their investigation, as necessary.

2.3.4.8 Soil Background Sampling

For use in the evaluation of the soil sample analytical results, the following steps will be taken to determine background concentrations for metals (TAL metals and hexavalent chromium), PAHs, and dioxins/furans in accordance with ICS methodology, as defined in ITRC's Incremental Sampling Methodology (EPA 2013b; ITRC 2012) and EA SOP 057 (Appendix G); NORM/TENORM may also be included if the initial survey supports its presence onsite:

1. Select a location where, based on historical photographs and potential for contaminant migration, anthropogenic activities are not expected to have impacted the surface or subsurface soil; the currently targeted location is the large field just north of the former location of Tank 5 (East Tank Farm) (Figure 10).
2. Place a grid 150 ft by 150 ft in size (assumes a residential exposure area [decision unit] of 0.5 acre) and split into cells 25 ft by 25 ft in size (36 cells total).
3. At each of the 36 sample increment locations (each designated by a pin flag) within the DU, collect a soil increment from 0.0–0.5 ft bgs. Surface vegetation, including grass and roots, will be removed at each sample increment location with a dedicated trowel, as appropriate. Place each of 36 increments into a dedicated and labeled resealable bag; this is the main background sample.
4. To collect the QC samples (duplicate and triplicate), repeat this process a second time for

the ICS duplicate using a different starting point and direction. Place each of 36 increments into a dedicated and labeled resealable bag (designated “-D” for duplicate).

5. Repeat this process a third time (and final) for the ICS triplicate using a yet different starting point and direction. Place each of 36 increments into a dedicated and labeled resealable bag (designated ‘-T” for the triplicate).
6. The background sample and its replicate samples will be submitted intact to the laboratory for appropriate preparation (drying, sieving, grinding, homogenization, and subsampling) and subsequent analysis for TAL metals, hexavalent chromium, PAHs (PAHs to be used as an indicator of anthropogenic activity), dioxins/furans; the samples will also be analyzed for NORM/TENORM, if any are detected during the reconnaissance survey.

The background evaluation will be performed once the analytical results are received per the most recent EPA guidance:

- *ProUCL Version 5.0.00, Technical Guide* (EPA 2013c)
- *ProUCL Version 5.0.00, User Guide* (EPA 2013d)
- *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites* (EPA 2002a).

2.3.5 Surface Water and Sediment Sampling

Surface water and sediment sampling activities may take place during Mobilization 1 pending funding availability and schedule; otherwise, this activity will occur during Mobilization 2.

Surface water and sediment will be collocated, with the exception of the samples to be collected at the bridge downstream from the site. As shown in the CSM diagram (Appendix A), contamination can be exchanged between these two media and transport of contamination to sediment and surface water along the streams in the area of influence of the site can also originate from upstream sources of contamination. Moreover, migration of sediment, especially during times of high water, can be significant along the stream.

To clarify the terminology used in this SAP, the locations where the intermittent West Tributary and perennial East Tributary enter Sand Creek will be called “confluences” and the points where drainages (features that do not contain water for any significant length of time) enter Sand Creek will be called PPEs.

2.3.5.1 Surface Water Sampling Methodology

Surface water samples will be collected directly into the sample containers in accordance with EA SOP 021 (Appendix G). An alternative sampling method involves pumping water from the sample location through dedicated Teflon™-lined polyethylene tubing using a peristaltic pump; the intake of the sample tubing will be placed 6 inches below the surface of the water. Surface water samples collected for dissolved metals will be field-filtered using 0.45-micron disposable filters. Field parameters collected during surface water sample collection may include surface water flow rate, water temperature, pH, conductivity, TDS, oxidation-reduction potential, and turbidity. Field data sheets are included in Appendix D. Coordinates for the sample locations will be obtained after sampling using a handheld GPS device. Sample locations may be adjusted based on existing field conditions.

2.3.5.2 Sediment Sampling Methodology

Sediment samples will be collected using sediment core samplers or laboratory-grade disposable scoops, in accordance with SOP 007 (Appendix G). AVS-SEM sediment sample containers will be completely filled to minimize head space. Field data sheets are included in Appendix D. Coordinates for the sample locations will be obtained after sampling using a handheld GPS device. Sample locations may be adjusted based on existing field conditions.

2.3.5.3 Surface Water and Sediment Sampling Program

Surface water and sediment samples will be collected from locations in flowing water bodies (Sand Creek and tributaries) and ponds. Due to the timeframe of operation for the Wilcox Oil Refinery, it is assumed that contaminant transport is fully developed. As such, media that are not presently contaminated are not anticipated to become so (i.e., no additional active primary releases, and steady-state to waning secondary releases). Consequently, if contaminant concentrations are below respective surface water or sediment criteria at a point of discharge, then the investigation at that location will be considered complete as the nature and extent of contamination is defined.

The sampling program proposed for surface water and sediment samples is presented below. Sample locations are provided on Figure 11 and details on the sampling program in Table 7. Additional surface water and sediment samples will be collected from seeps, the location in Sand Creek just below the seep, as well as from sand bar locations immediately downstream from the seeps; however, the seep locations could not be identified on Figure 11 at this time.

Samples will be collected from each location using the following methodology and in accordance with the U.S. Geological Survey's (USGS) *National Field Manual for the Collection of Water-Quality Data* (USGS 2014):

1. Collocated surface water/sediment pairs will be collected from each location, unless otherwise specified above.

2. All sediment samples will be collected from 0.0–0.5 ft bgs.

3. All surface water samples will be collected from 0.0–0.5 ft or shallower below the water surface; due to the flow in the creek and tributaries, the mixing of the water column deems this sampling depth representative.

4. All surface water and sediment samples will be collected from each location at the same time while moving upstream from the confluences as follows: from Sand Creek and East Tributary starting from Confluence 1 and from the West Tributary starting from Confluence 2. This manner of sampling will ensure that the water and sediment at the upstream sampling locations are not disturbed due to ongoing sample collection occurring downstream.

5. Locations of the drainages from former potential sources of contamination will be verified during the initial mobilization. Surface soil and sediment samples will be collected from the points of confluence of the streams with these drainage pathways. Soil samples collected from drainage pathways are discussed under the soil DQOs.

6. Locations of seeps will be identified during the reconnaissance, based on the conditions at the time of sampling.

Sample locations are specified as described below. The prescribed sample locations based on drainages and seeps will be considered first, before the criterion of 200 ft spacing between sample locations is applied. Sampling will be performed using the following methodology:

1. Along each stream/tributary, the locations will be selected no closer than 200 ft by walking upstream from a former sample location, and where deposition and accumulation of contaminants may take place. Sand Creek, East Tributary, and West Tributary are meandering streams; therefore, deposition and contaminant accumulation is anticipated within the point bar portion of the stream bed. For this reason, the sand bars are the locations where samples are proposed to be collected. To optimize sample collection, locations will also coincide, if possible, with places where drainage of surface runoff may be discharging contamination from site sources (PPEs) or confluences discussed below.

2. By the bridge at 8th Street, crossing Sand Creek:
   a. Location of surface water samples will include one (1) upstream and one (1) downstream from the bridge; if present, the sample locations will be from areas where a “black oily substance” may be visible.
   b. For sediment samples, five (5) locations are estimated, to be determined in the field during the site reconnaissance and based upon information from stakeholders regarding former observations of a “black oily substance” presence in the area.
   c. Sediment samples will be collected from 0.0–0.5 ft bgs and an additional sediment sample will be collected from 0.5–1.0 ft bgs.

3. At seep locations along Sand Creek, a sample of the seepage will be collected, if present. If a seep is identified by seeing a wet area on the sandstone above the water level, then a sample of surface water and sediment (if sediment is present) will be collected below the wet spot; in addition, a surface water/sediment pair will be collected from the nearest downstream location where a sand bar is present.

4. Soil will be collected at PPEs along Sand Creek where runoff drains from the site. Please

note that soil samples will be collected along the drainage pathways leading from the former potential source of contamination to the surface water to characterize the soil along this path; details on the soil samples are accounted for under the surface soil investigation.

5. Samples will be collected at locations where reference values for surface water and sediment can be obtained. These reference values will characterize upstream conditions of the flowing bodies of water, because water flowing in Sand Creek, East Tributary, and West Tributary may be influenced by contamination originating upstream of the site. Each water body will require its own upstream water quality data that will only be applicable to that particular stream. Reference values will be obtained as follows:
    a. For Sand Creek, from three (3) locations upstream of the site, one locations being at the bridge underneath the highway; (Upstream Condition 1a, 1b, and 1c)
    b. One location for the West Tributary that crosses the site (Upstream Condition 3)
    c. One location for the East Tributary, at discharge point from Pond P9 (Upstream Condition 2); Pond P9 is upstream of the site, but may be impacted by non-site-related contamination originating upstream from the site, so it cannot serve as reference for natural conditions and will not be characterized under this RI.

6. Pond locations are shown on Figure 11. Ponds P2 through P6 are independent ponds that rely on rain and runoff whereas ponds P1 and P7 are connected with stream flow. Ponds P1, P2, P3, P4, and P6 are isolated and associated with areas that were used in the past by the refinery as either separation ponds or tank storage areas. Pond P5 is a new pond excavated by the property owner, and it is located downgradient of a former crude oil storage tank location. Pond P8 is not associated with site activities, it appears to rely on rain and runoff, and it is considered to be representative of background conditions for the isolated ponds. The pond sampling program is as follows:
7. Collect surface water/sediment sample pairs from four (4) locations each from Ponds P2 through P6.
8. Collect surface water/sediment sample pairs from five (5) locations in Pond P1: inflow, outflow, 1 center, and 2 sides of the pond.
9. Collect surface water/sediment sample pairs from seven (7) locations for Pond P7: intake, outflow, 1 center, and 4 sides.
10. To obtain reference/background conditions for ponds, six (6) sampling locations are proposed from Pond P8, located east of the site; because of its location on the other side of the East Tributary, this pond is not considered to have been impacted by site activities.

It is anticipated that, depending on the time of year, some ponds/intermittent streams, such as the West Tributary, may not contain surface water. If completely dry, only the sediment samples will be collected as per the strategy outlined above. If the bodies of water are dry, the sediment samples collected will also be evaluated for exposure as the surface soil exposure medium. If there is water ponding in the intermittent streams, collocated ponded water and sediment will be collected from available locations, but at a frequency of not more than 1 sample every 200 ft.

In order to be able to assess the appropriate exposure routes and receptors for each surface water body, sampling personnel will make a sufficiently detailed description of the vegetation surrounding the site, and will note if there are any animals present or any traces of animal life. Based on these observations and information collected from the residents on how the surface water bodies are used (fishing, swimming, etc.), risk screening (and if screening criteria are exceeded, risk assessment) of a threat to the appropriate human and ecological receptors will be evaluated. The results for surface water and sediment samples will be also used to determine where biota samples will be collected during a subsequent mobilization (most likely, from the most contaminated locations).

If the wetlands survey indicates wetlands are present within the area of influence of the site, then additional surface water and sediment samples will be collected during a subsequent mobilization. Also, if the extent of contamination is not defined downstream, a plan for collecting additional samples will be developed and implemented during a subsequent mobilization.

2.3.6 Initial Assessment of Ground Water

Residential wells on and in the vicinity of the site have been sampled in the past; however, the analytical suite for which the samples were analyzed is not the complete COPC suite for the site. Moreover, PAHs and EDB were analyzed using analytical methods with detection limits above current risk-based screening levels and, as such, the results available to date may not be representative of ground water quality. As of the startup of the RI, little information is available for ground water beneath the site. Samples of infiltrated water have been collected over the time, but they are not representative of the quality of ground water in the regional aquifer. Although LNAPL is reported to be present in the church well located in Lorraine Process Area, there is a strong possibility that LNAPL is present in that well due to infiltration of contaminated water along the well casing or well annulus. Moreover, the hydrogeologic regime and the direction of ground water flow are unknown. Ground water monitoring wells will be installed utilizing conductive casing construction (to prevent downward migration of contaminants to lower water-bearing zones) during a subsequent mobilization. During drilling of these wells, the lithology will be characterized and other geotechnical data will be collected to fully assess the subsurface.

2.3.6.1 Geophysical Logging of Water Supply Wells

Existing public water supply wells to be sampled during Mobilization 1 will be geophysically logged, pending owner access and EPA technical direction. The information obtained through geophysical logging will assist with the understanding of the transport mechanism and provide some clarity on the potential presence of LNAPL in the church well from horizons above the regional aquifer.

EA will subcontract with a well pump service to pull and reset pumps in existing wells. The existing wells will be logged using gamma and resistivity logging instruments. Depending on availability, EPA will coordinate with the USGS to perform geophysical logging activities. As a contingency measure, EA will be use a subcontract with a geophysical logging firm to support the investigation in the case where the USGS is unavailable. EA will manage this effort in accordance with SOP 044 (Appendix G). EA will provide the necessary equipment and personnel to perform decontamination of these tools between well locations, and will also be responsible for the collection, characterization, and disposal of associated IDW in accordance with local, State, and Federal regulations.

2.3.6.2 Sampling of Residential Wells

Residential wells that are currently in use will be utilized to evaluate COPC concentrations in ground water at the site. The following wells are proposed for sampling as shown on (Figure 12):

- Three wells located on the East Tank Farm (GW-1, GW-3, and GW-4); GW-2 is reportedly plugged, which will be confirmed during reconnaissance activities.
- Three wells located north of the East Tank Farm (GW-5, GW-6, and GW-7)
- Two wells located south of the East Tank Farm (GW-8 and GW-9)

The following four additional wells that are not currently in use will also be sampled (Figure 12):

- One well located on the North Tank Farm (GW-11)
- One water supply well for the church and the vacant residence (parsonage) located at the former Lorraine Process Area (GW-10)
- Two wells located on the East Tank Farm (1 abandoned well located east of Tank 9, GW-15, and 1 well located west of Tank 6, GW-14).

The following two additional wells (operational status to be determined) will also be sampled (Figure 12):

- One well located north of the North Tank Farm (GW-12)
- One well located within the Wilcox Process Area (GW-13).

EA will coordinate with EPA prior to site mobilization to identify which locations are to be sampled and to ensure that the necessary access agreements are in place. Table 8 specifies the sample and analytical quantities and Table 12 specifies the required sample volume, container type, preservation technique, and holding times for the analytes.

Grab samples will be collected from all wells but different sampling methods will be utilized. Tap samples will be collected from the residential wells that are in use and are equipped with an operational pump. With the exception of the church well, which is known to contain LNAPL, wells will be purged by either letting the tap run or by other means and physical parameters monitored and logged using a calibrated water quality meter in accordance with EA SOP 014

(Appendix G). The parameters measured will be used to determine if the sample stream has been stabilized and it is representative of the water in the aquifer. The parameters that will be measured for stabilization are pH, temperature, and conductivity (EA SOPs 008, 009, and 012). If a pump is operational, these parameters will be measured during the 15 minutes prior to sampling or until the readings have stabilized (conductivity within ± 10%, pH within ± 0.5 pH units, and temperature within ±1 ºC). Other parameters may be monitored during purging, including oxidation-reduction potential and turbidity, but will not be used as stabilizing criteria. If the wells are not sampled from the tap, parameters will be measured periodically during the purging. Field parameters will be recorded on field forms provided in Appendix D. Sampling methods and equipment were selected to meet project objectives.

The four wells that are no longer in use will be sampled using the following methodology:

1. At the Lorraine Process Area, the well associated with the church and the vacant residence (parsonage) will be assessed and sampled as follows:
   a. The depth to LNAPL and the depth to water will be gauged with an interface probe.
   b. A bailer will be lowered into the well to obtain a sample of the LNAPL.
   c. A grab sample will be obtained of the ground water.

2. At the North Tank Farm, if the pump is still in the well, the pump will be energized and a tap sample will be collected as stated above. If the pump is not operational, a grab sample will be obtained from the water above the pump. If the pump is set higher in the well casing and a grab sample cannot be obtained, then the pump will be removed and a grab sample obtained.

3. The two wells located on the East Tank Farm will be purged and sampled using low-flow sampling methodology (EA SOP 048, Appendix G), if possible. If the wells cannot be sampled via low-flow methodology, then a grab sample will be collected with a disposable bailer after at least 3 volumes of water were purged and parameters stabilized.

The wells that will be sampled are shown on Figure 12 and the details for sampling and sample analysis are provided in Table 8.

2.3.6.3 Piezometer Installation and Sampling

Up to 10 piezometers will be installed where water may be seeping into Sand Creek from the Wilcox and Lorraine Process Areas and into the East Tributary from the former Tank 3 area located on the East Tank Farm. The location of the piezometers will be determined based on the information gathered through the infrared camera survey conducted during site reconnaissance. Once the seep locations are identified, the piezometers will be installed using a track-mounted DPT rig. The pre-packed piezometers will be constructed of 1-inch-diameter Schedule 40 polyvinyl chloride (PVC) well casing and screen with a filter pack attached. The piezometers will be installed in accordance with EA SOP 032 (Appendix G). Once the piezometers are installed they will be developed and then sampled using low-flow sampling methodology in accordance with EA SOP 048 (Appendix G). Water samples will be analyzed by a fixed laboratory for the suite of analytes presented in Table 8.

2.3.7 Vapor Intrusion Characterization

Two vacant residences within the Wilcox and Lorraine Process Areas and the church that will be sampled during the initial mobilization are shown on Figure 13 and the details for sampling and sample analysis are provided in Table 9.

2.3.7.1 Vapor Intrusion Sampling Methodology

EA will investigate the vapor intrusion pathway by conducting sub-slab soil gas and indoor air sampling at the church and the parsonage at the Lorraine Process Area and the residence located in the Wilcox Process Area, as summarized in Table 9. Sub-slab soil gas and indoor air samples will be analyzed for the VOCs and naphthalene. Although the methodology exists for analyzing PAHs in air, the reporting limits are above the screening level requirements. As a result, the samples will only be analyzed for VOCs and the naphthalene concentration will be used to determine if further PAH analysis will be warranted. If concentrations of mercury and/or cyanide in soil samples exceed project screening levels, then these COPCs will be included during a subsequent sampling event.

Based on the results of the vapor intrusion assessment, a soil gas survey may be performed during a subsequent mobilization at the residential properties located on the North Tank Farm and East Tank Farm.

2.3.7.2 Vapor Intrusion Sampling Program

Sub-slab soil gas and indoor air samples will be collected from occupied areas of the subject residence or building in accordance with the vapor intrusion sampling procedures and applicable site-specific SOP (Appendix F). Sub-slab soil gas samples will be used to evaluate the potential concentration of vadose zone source material and the attenuation of vapors from source material into indoor air. Indoor air samples will also be used to evaluate the attenuation of vapors from source material to indoor air, as well as provide an exposure point concentration for the building occupants.

2.3.8 Waste Delineation

During Mobilization 1, the waste areas will be delineated using a hand-held GPS unit to determine the lateral extent of area where waste disposal is visible. EA will also determine if more than one type of waste is present at each location. The waste piles will be sampled during Mobilization 2.

2.3.9 GPS Survey

During Mobilization 1 of the RI field program, EA staff will survey the following using GPS equipment:

- Sample locations for all media
- Seeps along Sand Creek
- Waste areas
- Wetlands extent
- Any other relevant site features.

The survey will be performed using hand-held Real-Time Kinetic GPS equipment. If more precise elevation or boundary surveys will be required, they will be performed by a State of Oklahoma-Registered Professional Licensed Surveyor during a subsequent mobilization. After field activities are complete, the survey data will be used to generate accurate maps illustrating the information collected.

The following GPS data attributes for each location will be logged:

- Latitude and longitude
- Elevation
- Survey method
- Datum
- Maximum Positional Dilution of Precision
- GPS date and time
- Total positions collected at each well location.

2.4 SAMPLE PROCESSING

Samples for fixed laboratory analysis will be processed and packaged in accordance with the *Contract Laboratory Program Guidance for Field Samplers* (EPA 2014c) and/or SOP 004 (Appendix G), as applicable.

2.5 DECONTAMINATION

Re-usable field equipment utilized during the RI will be decontaminated prior to and after use in accordance with EA SOP 005 (Appendix G). Decontamination of field equipment will occur in buckets, plastic containers, or other similar containers with sealing lids, and the resulting fluid will be transferred to properly labeled IDW containment vessels (e.g., 55-gallon drums) staged in a designated staging area (Support Zone) on the Lorraine Process Area property. The decontamination fluids will be properly sampled and disposed of following local, State, and Federal guidelines (see Section 2.6).

2.6 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

Decontamination water, purge water, drill cuttings, and unused portions of soil samples will be drummed, sealed, labeled, and stored at the designated staging area (Support Zone) until profiled for acceptance at an approved disposal facility (EA SOP 042, Appendix G). IDW samples will be submitted to the EA-subcontracted laboratory for profiling.

For IDW, Landfill Disposal Restrictions will dictate sample quantities and analyses, which may include but not limited to:

- VOCs, SVOCs, and TAL metals by TCLP
- TPH
- Corrosivity
- Reactivity
- Corrosivity
- Ignitability.

2.7 SAMPLE DESIGNATION

Each sampling location will be designated with a unique alphanumeric designation.

2.7.1 Soil and Waste Sample Designation

Soil and waste samples will include the site area or location identifier, as follows:

- BKG = Soil background
- DR = Drainage pathway
- ETF = East Tank Farm
- LPA = Lorraine Process Area
- WPA = Wilcox Process Area.

2.7.1.1 Soil Samples from Borings

Soil borings will include the area designation, followed by "SB" for borings installed by DPT or HSA techniques, the sequential boring number, and the bottom depth for the sample interval (in feet), as follows:

- For example, Soil Boring Sample ID WPA-SB-14-0.5 describes a soil sample collected from a Boring Location No. 14 in the Wilcox Process Area, with the bottom of the sample depth interval at 0.5 ft bgs.

2.7.1.2 Background Soil

The soil sample for determination of background concentrations will be designated by the background ID ("BKG"), followed by the bottom of the sample depth, in feet. As such, the background ICS sample will be labeled BKG-0.5.

The QC replicate samples will be labeled the same as the actual sample, with the extension "-D" for the duplicate and "-T" for the triplicate: BKG-0.5-D and BKG-0.5-T, respectively.

2.7.2 Surface Water and Sediment Sample Designation

For surface water and sediment samples from water bodies, the location identifiers will be assigned based on the associated body of water or pond, as follows:

- SC = Sand Creek
- ET = East Tributary
- WT = West Tributary
- SCPPE = PPE in Sand Creek
- C1 = Confluence of Sand Creek and East Tributary
- C2 = Confluence of Sand Creek and West tributary
- SCUC1, SCUC2, SCUC3 = Upstream conditions for Sand Creek
- ETUC = Upstream conditions for East Tributary
- WTUC = Upstream conditions for West tributary
- SCSP = Seep location along Sand Creek
- SCBR = Sand Creek at 8th Street Bridge
- PX = Pond X, where X = 1, 2, 3, etc.

Samples collected from the body of water will be assigned the appropriate Location ID, followed by the designator "SW" for surface water or "SD" for sediment; for sediment, the bottom of the sediment interval will also be recorded in feet, as follows:

- SC-SW-02 and SC-SD-02-0.5 – surface water and sediment samples collected within Sand Creek from Location 02; the bottom depth of the sediment sample is 0.5 ft bgs.

- ET-SW-07 and ET-SD-07-0.5 – surface water and sediment samples collected in East Tributary from Location 07; the bottom depth of the sediment sample is 0.5 ft bgs.

- SCPPE-SW-04 and SCPPE-SD-04-0.5 – surface water and sediment samples collected from drainage pathway discharging water into Sand Creek at PPE 04; the bottom depth of the sediment sample is 0.5 ft bgs.

- C1-SW and C1-SD-0.5 – surface water and sediment samples collected from the Confluence of Sand Creek and East Tributary; the bottom depth of the sediment sample is 0.5 ft bgs.

- ETUC-SW and ETUC-SD-0.5 – surface water and sediment samples collected for characterization of upstream conditions for the East Tributary; the bottom depth of the sediment sample is 0.5 ft bgs.

- SP-SW-XX – seep water sample collected from location of Seep XX.

- SCSP-SW-XX and SCSP-SD-XX-0.5 – surface water and sediment samples collected from location of Seep XX along Sand Creek; the bottom depth of the sediment sample is 0.5 ft bgs.

- SCBR-SW-XX and SCBR-SD-01-0.5 – surface water and sediment samples collected from Location XX in the vicinity of the bridge; the bottom depth of the sediment sample is 0.5 ft bgs.

- P5-SW-01 and P5-SD-01-0.5 – surface water and sediment samples collected from Location 01 in Pond 5; the bottom depth of the sediment sample is 0.5 ft bgs.

2.7.3 Ground Water Sample Designation

All ground water samples, regardless of provenance, will be designated as “GW” followed by a sequential number associated with the location of the residential well: for example, GW-01.

Water samples collected from piezometers will be will be assigned the appropriate Location ID, followed by the designator “PZ”, as follows:

- LPA-PZ-01 – water sample collected within the Lorraine Process Area from Piezometer 01.

2.7.4 Vapor Intrusion Sample Designation

Samples collected for evaluation of vapor intrusion will be designated by area, followed by one of the following designations:

- CS = Crawl space vapor sample
- IA = Indoor air sample
- SG = Soil gas sample
- SGBG = Soil gas background sample
- SS = Sub-slab vapor sample
- VIBG = Vapor intrusion background air sample.

These designations will be followed by a sequential number associated with the sample location; for example, LPA-IA-01.

2.7.5 Field and Laboratory Quality Control Sample Designation

Field and laboratory QC samples will use the designations discussed below.

Field Duplicate Samples

Field duplicate samples will be identified by adding a "D" to the end of the sample designations described above; for example: GW-09-D. The replicate samples for background that will be collected using ICS (duplicate and triplicate) will be labeled as described in the previous section.

Aqueous Field, Trip, and Equipment Rinsate Blank Sample Designation

Aqueous field blank (FB), trip blank (TB), and equipment rinsate blank (ER) samples will be identified by two fields beginning with "FB", "TB", or "ER" respectively, followed by a dash "-", then the date in the following format YYMMDD. For example, a trip blank for samples submitted on 15 July 2016 would have the following sample identification number "TB-160715". If two field, trip, or equipment rinsate blanks will be collected on the same day, an additional, sequential numeric field will be added; for example: TB-160715-1 and TB-160715-2.

Matrix Spike/Matrix Spike Duplicate and Matrix Spike/Matrix Duplicate

MS/MSD and MS/MD samples will not have specific sample identifiers to identify them as such, but the samples will be labeled as described above and will be identified on the chain-of-custody record as having additional aliquots provided for the preparation of these QC samples by the laboratory.

Source Water Blank Sample Designation

Source water blanks (SWB), if applicable, will be identified by SWB followed by a dash "-", then the date in the following format YYMMDD. For example a source water blank submitted on 13 July 2016 would have the following sample identification number "SWB-160713". If two source water blanks will be sent to the laboratory for analysis on the same day, an additional field will be added; for example: SWB-160713-1 and QTB-160713-2.

2.8 SAMPLE CONTAINER, VOLUME, PRESERVATION, AND HOLDING TIME REQUIREMENTS

Table 12 specifies the required sample volume, container type, preservation technique, and holding time for each analysis that is to be conducted during each phase of sampling. Required containers, preservation techniques, and holding times for field QC samples, such as field duplicates, will be the same as for investigative samples, but may require additional volumes.

2.9 SAMPLE HANDLING AND CUSTODY

Each sample collected will be traceable from the point of collection through analysis and final disposition to ensure sample integrity. Sample integrity helps to ensure the legal defensibility of the analytical data and subsequent conclusions. Sample handling will follow CLP protocols as required in EPA's *Contract Laboratory Program Guidance for Field Samplers* (EPA 2014c).

The EA field team will use EPA's data management system known as Scribe to generate chain-of-custody records in the field. Applicable copies of generated Scribe files will be delivered to EPA data management personnel as required by CLP and EPA Region 6 protocols.

2.10 ANALYTICAL METHODS REQUIREMENTS

The source of analytical services to be provided will be determined in part by DQOs and the intended use of the resulting data. EA will use EPA-approved methods for laboratory analyses of the samples.

EA will follow the analytical services request procedures that are outlined EA's Analytical Services Delivery Plan (EA 2005). If an analytical system fails, the EA QA officer will be notified, and corrective action will be taken. In general, corrective actions will include stopping the analysis, examining instrument performance and sample preparation information, and determining the need to re-prepare and reanalyze the samples.

Laboratories that are subcontracted by EA or EPA will conduct definitive laboratory analysis of samples. Table 12 lists the laboratory analytical methods for this project. Appropriate methods of sample preparation, cleanup, and analyses are based on specific analytical parameters of interest, sample matrices, and required quantitation limits. In addition, Appendix B provides the detection and quantitation limits for both CLP and non-CLP analytical methods to demonstrate that the selection of the analytical methods satisfies the project DQOs.

2.10.1 Field Analytical Methods

Water quality parameters that include pH, temperature, specific conductivity, oxidation-reduction potential, and turbidity will be monitored using field-based methods during the collection of ground water and surface water samples. In addition, ground water will also be monitored for dissolved oxygen content. EA will follow manufacturer-recommended procedures for operating field equipment.

2.10.2 Fixed-Laboratory Analytical Methods

Fixed-laboratory analyses will be conducted by EPA Region 6 Laboratory, a designated CLP laboratory, or subcontracted by EA to a commercial laboratory. In the case of ground water, for analyte groups that could be analyzed by either a CLP or subcontract laboratory (e.g., VOCs, SVOCs, metals), the sample will be shipped to the EA subcontracted laboratory if non-aqueous phase liquid (free product) or a strong petroleum odor is observed in the sample; otherwise, the samples may be analyzed by the CLP laboratory. Samples submitted to the analytical laboratory will be analyzed in accordance with analytical methods identified in Table 12. Modifications to analytical methods that may be required to manage atypical matrices or to achieve low quantitation limits are not anticipated. Decisions regarding the use and type of method modifications will be made during the procurement of laboratories, as different laboratories have equipment and SOPs that generate varying quantitation limits.

The analytical method reference sheets and EPA CLP CRQLs for methods to be used for this project are provided in Appendix C.

2.11 QUALITY CONTROL REQUIREMENTS

Various field and laboratory QC samples and measurements will be used to verify that analytical data meet the QA objectives. Field QC samples and measurements will be collected to assess the influence of sampling activities and measurements on data quality. Similarly, laboratory QC samples will be used to assess how the laboratory's analytical program influences data quality. This section describes the QC samples that are to be analyzed during the site sampling activities for: (1) each field and laboratory environmental measurement method and (2) each sample matrix type. Table 4 shows the acceptance criteria for each type of QC sample and Table 13 presents the frequency of QC samples to be collected in support of the sampling activities at the site.

2.11.1 Field Quality Control Requirements

Field QC samples will be collected and analyzed to assess the quality of data that are generated by sampling activities. These samples will include laboratory QC samples collected in the field, field duplicates, trip blanks (for VOCs only), equipment rinsates, MS/MSD/MDs, and temperature blanks. QC samples collected in the field for fixed-laboratory analysis are presented in Table 13.

Field duplicates are independent samples that are collected as close as possible, in space and time, to the original investigative sample. Field duplicates can measure the influence of sampling and field procedures on the precision of an environmental measurement. They can also provide information on the heterogeneity of a sampling location. Field duplicates will be collected at a minimum frequency of one for every 10 investigative samples, as listed in Table 13. Immediately following collection of the original sample, the field duplicates are collected using the same collection method.

Field blanks are collected to assess: (1) impact from ambient air conditions during sample collection; (2) cross-contamination during sample collection, preservation, and shipment, as well as in the laboratory; and (3) cleanliness of the sample containers and preservatives. Field blank samples consist of sample containers filled with laboratory-grade, organic-free water. Field blank samples are typically associated with ground water sample collection for VOC analysis at a frequency of one field blank per each day of ground water sampling activities or one per site. Field blanks may be collected for other media and analytes as dictated by site conditions during investigative sampling activities. If a contaminant is detected in the blank samples above the method detection limit, the result for associated field samples that contain the same contaminant will be qualified as potentially not detected if the concentration of the field sample is less than five times the concentration found in the blank.

Equipment rinsate blanks are collected when non-dedicated or non-disposable sampling equipment is used to collect samples. These blanks assess the cleanliness of the sampling equipment and the effectiveness of equipment decontamination. Equipment rinsate blanks are collected by pouring analyte-free water over the decontaminated surfaces of sampling equipment that contacts sampling media. Equipment rinsate blanks are collected after sampling equipment has been decontaminated, but before the equipment is reused for sampling. If non-dedicated or non-disposable equipment is used, equipment rinsate blanks will be collected in accordance with the frequency listed in Table 13.

MS/MSD samples are laboratory QC samples that will be collected for organic methods; MS/MD samples will be collected for inorganic methods. QC samples (e.g., MS/MSD, MS/OS/MD) typically require double or triple the normal sample volume, depending on analytical laboratory specifications. In the laboratory, MS/MSD and MS/OS/MD samples are split and MS/MSD samples are spiked with known amounts of analytes. Analytical results for MS/MSD and MS/OS/MD samples are used to measure the precision and accuracy of the laboratory's organic and inorganic analytical methods, respectively. Each of these QC samples will be collected and analyzed at a frequency of one for every 20 (5 percent) investigative samples or one per analytical batch for CLP laboratories, subcontracted commercial laboratories, or in accordance with the requirements of the EPA Region 6 Laboratory.

Trip blanks are analyzed for VOCs only. VOC samples are susceptible to contamination by diffusion of organic contaminants through the Teflon-lined septum of the sample vial; therefore, a VOC trip blank will be analyzed to monitor for possible sample contamination. Also, the trip blank will screen for possible contamination of VOC samples during handling and shipment from the field to the laboratory. One trip blank will be placed in each cooler that contains aqueous VOC samples.

Temperature blanks are containers of deionized or distilled water that are placed in each cooler shipped to the laboratory. The temperature blank is used to monitor sample preservation during shipping and upon receipt at the laboratory. The temperature blank should measure <6°C upon receipt at the laboratory.

2.11.2 Laboratory Quality Control Requirements

Laboratories that perform analytical work under this project must adhere to a QA program that is used to monitor and control laboratory QC activities. Each laboratory must have a written QA manual that describes the QA program in detail. The laboratory QA Manager is responsible for ensuring that laboratory internal QC checks are conducted in accordance with EPA methods and protocols, the laboratory's QA manual, and the requirements of this SAP.

Many of the laboratory QC procedures and requirements are described in EPA-approved analytical methods, laboratory method SOPs, and method guidance documents.

The EPA methods specify the preparation and analysis of QC samples, and may include, but are not limited to, the following types: (1) LCSs; (2) method blanks; (3) MS, MSD, and MD samples; (4) surrogate spikes; and (5) standard reference materials or independent check standards. The following subsections discuss the QC checks that will be required for this project.

2.11.2.1 Laboratory Control Sample

LCSs are thoroughly characterized, laboratory-generated samples that are used to monitor the laboratory's day-to-day performance of analytical methods. The results of LCS analyses are compared to well-defined laboratory control limits to determine whether the laboratory system is in control for the particular method. If the system is not in control, corrective action will be implemented. Appropriate corrective actions will include: (1) stopping the analysis, (2) examining instrument performance or sample preparation and analysis information, and (3) determining whether samples should be re-prepared or reanalyzed.

2.11.2.2 Method Blanks

Method blanks, which are also known as preparation blanks, are analyzed to assess the level of background interference or contamination in the analytical system and the level that may lead to elevated concentration levels or false-positive data. Method blanks are required for all analytical methods and prepared and analyzed at a frequency of one method blank per every 20 samples or one method blank per sample batch, if the batches consist of fewer than 20 samples.

A method blank consists of reagents that are specific to the analytical method and are carried through every aspect of the analytical procedure, including sample preparation, cleanup, and analysis. The results of the method blank analysis will be evaluated in conjunction with other QC information to determine the acceptability of the data generated for that batch of samples. Ideally, the concentration of a target analyte in the method blank will be below the reporting limit for that analyte. For certain known common laboratory contaminants, a higher concentration is allowed in the method blank sample.

If the method blank results do not meet method criteria, the source of contamination must be investigated, and appropriate corrective action must be taken and documented. This investigation includes an evaluation of the data to determine the extent of the contamination and its effect on sampling results. If a method blank is within control limits but analysis indicates a concentration of analytes that is above the reporting limit, an investigation should be conducted to determine whether corrective action could eliminate an ongoing source of target analytes.

For organic and inorganic analyses, the concentration of target analytes in the method blank must be below the CRQL or RL for that analyte for the blank to be considered acceptable. An exception may be made for common laboratory contaminants (such as methylene chloride, acetone, toluene, 2-butanone, and phthalate esters) that may be present in the blank at up to five times the reporting limit. These compounds are frequently detected at low levels in method blanks and associated with sample extraction and analysis for organic parameters.

2.11.2.3 Matrix Spikes

MSs and MSDs are aliquots of an environmental sample for organic analysis to which known concentrations of target analytes have been added. The MS is used to evaluate the effect of the sample matrix on the accuracy of the analysis. If there are many target analytes, they will be divided into two to three spike standard solutions. Each spike standard solution will be used alternately. The MS, in addition to an unspiked aliquot, will be taken through the entire analytical procedure, and the recovery of the analytes will be calculated. Results will be expressed in terms of percent recoveries and RPD. The percent recoveries of the target analytes and compounds are calculated and used to determine the effects of the sample matrix on the precision and accuracy of the analytical method. The RPD between the MS and MSD results is used to evaluate method precision. If results fall outside control limits, corrective action will be performed or data may be qualified.

2.11.2.4 Laboratory (Matrix) Duplicates

MDs, which are also called laboratory duplicates, are prepared and analyzed for inorganic analyses to assess method precision. Two aliquots of sample material are taken from one sample and processed simultaneously without adding spiking compounds. The MD and the original sample aliquot are taken through the entire analytical procedure, and the RPD of the duplicate result is calculated. Results are expressed as RPD and are compared to control limits that have been established for each analyte.

2.11.2.5 Surrogate Spikes

Surrogates are organic compounds that are similar in nature to certain of the target analytes of interest in chemical properties but are not normally found in environmental samples. Surrogates are added to field and QC samples, before the samples are extracted, to assess the efficiency of the extraction procedure and to assess the bias that is introduced by the sample matrix. Results are reported in terms of percent recovery. Individual analytical methods may require sample reanalysis based on surrogate criteria.

The laboratory will use surrogate recoveries mainly to assess matrix effects on sample analysis. Obvious problems with sample preparation and analysis (such as evaporation to dryness or a leaking septum) that can lead to poor surrogate spike recoveries must be eliminated before low surrogate recoveries can be attributed to matrix effects.

2.11.3 Data Quality Indicators

This section describes how QA objectives for precision, accuracy, completeness, and sensitivity are measured, calculated, and reported.

2.11.3.1 Precision

Precision of many analyses is assessed by comparing analytical results of MS and MSD sample pairs for organic analyses, field duplicate samples, laboratory duplicate samples (MDs), and field replicate measurements. If precision is calculated from two measurements, it is normally measured as RPD. If precision is calculated from three or more replicates, relative standard deviation is calculated.

2.11.3.2 Accuracy

The accuracy of many analytical methods is assessed by using the results of MS and MSD samples for organic analyses, MS samples for inorganic analyses, surrogate spike samples, LCSs, standard reference materials, independent check standards, and measurements of instrument responses against zero and span gases.

For measurements in which spikes are used, percent recovery will be calculated.

2.11.3.3 Completeness

Completeness is a measure of the percentage of project-specific data that are valid. Valid data are obtained when samples are collected and analyzed in accordance with QC procedures outlined in this SAP, and when QC criteria are met and do not affect data usability.

When data validation is completed, the percent completeness value will be calculated by dividing the number of useable results by the total number of sample results planned for this investigation. The objective for data completeness is 90 percent for the RI.

Completeness will also be evaluated as part of the DQA process (EPA 2006c, 2006d). This evaluation will help determine whether limitations are associated with the decisions to be made based on the data collected.

2.11.3.4 Sensitivity

The achievement of MDLs, CRQLs, and RLs depends on instrument sensitivity and matrix effects. Therefore, it is important to monitor the instrument sensitivity to ensure data quality and to ensure that analyses meet the QA objectives established for sensitivity.

2.11.4 Instrument and Equipment Testing, Inspection, and Maintenance Requirements

This section outlines testing, inspection, and maintenance procedures for field equipment and instruments and for laboratory instruments.

2.11.4.1 General Requirements

Testing, inspection, and maintenance methods and frequency will be based on: (1) the type of instrument; (2) the instrument's stability characteristics; (3) the required accuracy, sensitivity, and precision of the instrument; (4) the instrument's intended use, considering project-specific DQOs; (5) manufacturer's recommendations; and (6) other conditions that affect measurement or operational control. For most instruments, preventive maintenance is performed in accordance with procedures and schedules recommended in (1) the instrument manufacturer's literature or operating manual, or (2) SOPs associated with particular applications of the instrument.

In some cases, testing, inspection, and maintenance procedures and schedules will differ from the manufacturer's specifications or SOPs. This can occur when a field instrument is used to make critical measurements or when the analytical methods that are associated with a laboratory instrument require more frequent testing, inspection, and maintenance.

2.11.4.2 Field Equipment and Instruments

Leased field equipment and instruments will be used to conduct onsite media sampling and preparation. The vendor will be responsible for thoroughly checking and calibrating field equipment and instruments before they are shipped or transported to the field. Copies of testing, inspection, and maintenance procedures will be shipped to the field with the equipment and instruments.

After the field equipment and instruments arrive in the field, they will be inspected for damage. Damaged equipment and instruments will be replaced or repaired immediately. Battery-operated equipment will be checked to ensure full operating capacity; if needed, batteries will be recharged or replaced.

Following use, field equipment will be decontaminated properly before being returned to the source. When the equipment is returned, copies of field notes regarding equipment problems will be included so that problems are not overlooked and necessary equipment repairs are performed.

Table 11 lists the proposed instruments, detectors, and equipment (or their equivalent) to be used onsite during field screening for NORM and TENORM. Table 14 lists all other field equipment and the prescribed calibration, maintenance, testing, and inspection protocols.

2.11.4.3 Laboratory Instruments

Laboratories that analyze samples collected under the EPA Region 6 RAC II program must have a preventive maintenance program that addresses: (1) testing, inspection, and maintenance procedures; and (2) the maintenance schedule for each measurement system and required support activity. This program is usually documented by a SOP for each analytical instrument that is to be used. Typically, the program will be laboratory-specific; however, it should follow requirements outlined in EPA-approved guidelines. Some of the basic requirements and components of such a program are as follows:

- As a part of its QA/QC program, each laboratory will conduct a routine preventive maintenance program to minimize instrument failure and other system malfunction.

- An internal group of qualified personnel will maintain and repair instruments, equipment, tools, and gauges. Alternatively, manufacturers' representatives may provide scheduled instrument maintenance and emergency repair under a repair and maintenance contract.

- The laboratory will perform instrument maintenance on a regularly scheduled basis. The scheduled service of critical items should minimize the downtime of the measurement system. The laboratory will prepare a list of critical spare parts for each instrument. The laboratory will request the spare parts from the manufacturer and will store the parts.

- Testing, inspection, and maintenance procedures described in laboratory SOPs will be performed in accordance with manufacturer's specifications and the requirements of the specific analytical methods that are used.

- Maintenance and service must be documented in service logbooks (or the site-specific logbook) to provide a history of maintenance records. A separate service logbook should be kept for each instrument; however, due to the limited scope of this project, the service records will be maintained in the site-specific field logbook. Maintenance records will be traceable to the specific instrument, equipment, tool, or gauge.

- The laboratory will maintain and file records that are produced as a result of tests, inspections, or maintenance of laboratory instruments. These records will be available for review by internal and external laboratory system audits that are conducted under the EPA Region 6 RAC II program.

2.12 INSTRUMENT CALIBRATION AND FREQUENCY

This section describes the procedures for maintaining the accuracy of field equipment and laboratory instruments that are used for field tests and laboratory analyses. The equipment and instruments should be calibrated before each use or, when not in use, on a scheduled basis.

2.12.1 Field Equipment

EA will perform calibration of field equipment during the site field activities specified herein. Calibration of the field equipment (e.g., multi-parameter water quality meter) will be conducted on a daily basis following manufacturer recommendations, and will be performed prior to sample analysis activities. Should readings appear to be questionable during sample analysis, EA will recalibrate the equipment as deemed necessary. The equipment calibration procedures described below will be followed.

Equipment will be maintained and calibrated with sufficient frequency and in such a manner that the accuracy and reproducibility of results are consistent with the manufacturer's specifications and with project-specific DQOs. Upon arrival of the field equipment, EA field personnel will examine it to verify that it is in good working condition. The manufacturer's operating manual and instructions that accompany the equipment will be consulted to ensure that calibration procedures are followed. Measuring and testing equipment may be calibrated either internally—by using in-house reference standards—or externally—by agencies, manufacturers, or commercial laboratories. Calibration records will contain a reference identifying the source of the procedure and, where feasible, the actual procedure. Each piece of measuring and testing equipment will also be accompanied by an equipment use log. The equipment use log (which may be contained within the site-specific field logbook) will be kept current and may contain the following information: (1) date of use; (2) times of use; (3) operating and assisting technicians; (4) calibration status; and (5) comments.

2.12.2 Laboratory Instruments

Laboratory instrumentation that is used to analyze samples collected under the EPA Region 6 RAC II program will be calibrated on the basis of written SOPs that are maintained by the laboratory. Calibration records (including the dates and times of calibration and the names of the personnel performing the calibration) will be filed at the location at which the analytical work was performed and maintained by the laboratory personnel who performed QC activities. Subcontractor laboratories may conduct laboratory work under the EPA Region 6 RAC II program. The laboratory QA Manager is responsible for ensuring that laboratory instruments are calibrated in accordance with the requirements of this SAP.

The laboratories will follow the method-specific calibration procedures and requirements for laboratory measurements. Calibration procedures and requirements will also be provided, as appropriate, for laboratory support equipment, such as balances, mercury thermometers, pH meters, and other equipment that is used to take chemical and physical measurements.

2.13 REQUIREMENTS FOR INSPECTION AND ACCEPTANCE OF SUPPLIES AND CONSUMABLES

The EA Project Manager is responsible for identifying the types and quantities of supplies and consumables that are needed for field activities and collecting the samples for this Task Order. The EA Project Manager is also responsible for determining acceptance criteria for these items. When supplies are received, the EA field personnel will check packing slips against purchase orders and inspect the condition of supplies before the supplies are accepted for use on a project. If the supplies do not meet the acceptance criteria, deficiencies will be noted on the packing slip and purchase order. Afterward, the item will be returned to the vendor for replacement or repair.

2.14 DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENTS)

For this project, EA anticipates acquiring data from non-direct measurements such as databases, spreadsheets, and literature files.

2.15 DATA MANAGEMENT

A comprehensive data management program has been designed to assure that: (1) multiple information sources will result in similar data sets; and (2) data management practices will be adequate for the types of data processing required by a task order. Site team members will follow these protocols to assure results will have uniform units of measure, analytical methods, and reporting forms.

Data for this project will be obtained from a combination of sources, including field measurements, subcontracted fixed laboratories, EPA Region 6 Laboratory, and CLP laboratories. The data-gathering process requires a coordinated effort and will be conducted by project staff members in conjunction with potential data producers. The data will be obtained from the analytical service provider, when appropriate, in the form of an EDD, in addition to the required CLP Level IV type analytical data package. Data verification and validation will be conducted before associated results are presented or are used in subsequent activities.

Data tracking is essential to ensure timely, cost-effective, and high-quality results. Data tracking begins with sample chain-of-custody. When the analytical service provider receives custody of the samples, the provider will send a sample acknowledgment to EA. The sample acknowledgment will confirm sample receipt, condition, and required analyses. The EPA tracking software (Scribe) will contain pertinent information about each sample and can track the data at each phase of the process. The tracking software carries the data through completion of the data validation.

EA will validate 10% of the investigative analytical data received from the subcontractor laboratory to ensure that the confirmatory data are accurate and defensible. A partial review will be conducted on the remaining 90% of the data received from the subcontractor laboratory. All data will be evaluated for usability by EA in accordance with EPA CLP guidelines for data review (EPA 2014a, 2014b).

As a part of the data validation process, EDDs will be reviewed against hard copy deliverables to ensure accurate transfer of data. In addition, data will be reviewed for PARCC and sensitivity indicators to determine whether project DQOs have been met. Subsequent to the data validation, qualifiers will be applied to the data as necessary to indicate the usability of the data. These qualifiers will be placed on the data that is maintained in the project-specific electronic database. Upon completion of the data validation process, the electronic data will be released to the EA Project Manager for reporting.

There are two independent checks to ensure that sample data management is adequate and to ensure that the appropriate quality control samples are collected. The Sample Team Leader provides an initial check of the sampling program to ensure that the appropriate number and type of quality control samples are collected per the SAP. In addition, it is the Site Manager’s responsibility to provide oversight and independent technical review of the sample collection efforts on a daily and weekly basis.

3. ASSESSMENT AND OVERSIGHT

This section describes the field and laboratory assessments that may be conducted during this project, the individuals responsible for conducting assessments, corrective actions that may be implemented in response to assessment results, and how quality-related issues will be reported to EA and EPA.

3.1 ASSESSMENT AND RESPONSE ACTIONS

Under the EPA Region 6 RAC II program, performance and system audits of field and laboratory activities may be conducted to verify that sampling and analysis are performed in accordance with the following:

- Performance and system audits
  - Audit personnel
  - Audit scope of work
  - Audit frequencies
  - Audit reports.

- Corrective action
  - Sample collection and field measurements
  - Laboratory analyses.

Nonconforming items and activities are those that do not meet the project requirements, procurement document criteria, and approved work procedures. Nonconformance may be detected and identified by the following personnel:

- Project personnel—During field operations, supervision of subcontractors, and field inspections

- Testing personnel—During preparation for and performance of tests, equipment calibration, and QC activities

- QA personnel—During the performance of audits, surveillance, and other QA activities.

Each nonconformance that affects quality will be documented by the person who identifies or originates the nonconformance. Documentation of nonconformance will include the following components:

- Description of nonconformance.

- Identification of personnel who are responsible for correcting the nonconformance and, if verification is required, for verifying satisfactory resolution.

- Method(s) for correcting the nonconformance (corrective action) or description of the variance granted.

- Proposed schedule for completing corrective action and the corrective action taken.

Nonconformance documentation will be made available to the EA Project Manager, EA QA Officer, and subcontractor (e.g., subcontracted commercial laboratories) management personnel, as appropriate.

The field personnel and QA personnel, as appropriate, are responsible for notifying the EA Project Manager and the EA QA Officer of the nonconformance. In addition, the EA Project Manager and the project staff, as appropriate, will be notified of significant nonconformance that could affect the results of the work. The EA Project Manager is responsible for determining whether notification to EPA is required.

The completion of corrective actions for significant nonconformance will be documented by QA personnel during future auditing activities. Significant recurring nonconformance will be evaluated by project and QA personnel, as appropriate, to determine its cause. Appropriate changes will be instituted, under corporate or project procedures, to prevent recurrence. When such an evaluation is performed, the results will be documented.

3.2 REPORTS TO MANAGEMENT

Effective management of environmental data collection operations requires timely assessment and review of measurement activities. It is essential that open communication, interaction, and feedback be maintained among project participants, including: (1) the EA QA Officer, EA Program Manager, EA Project Manager, technical staff, and laboratory subcontractors; and (2) the EPA Region 6 TOM and EPA QA Officer.

During the RI field program, EA will prepare weekly reports that summarize the following elements:

- Work progress since the last weekly report

- Site observations, problems, and decisions

- Problems that may impede planned progress

- Safety-related observations, incidents, or potential safety problems and the corrective action(s) taken to mitigate the problem(s)

- Corrective measures and procedures to regain the planned schedule, if required

- QA/QC activities (e.g., number of QC samples)

- Work scheduled for the next work period.

EA prepares monthly progress reports for each Task Order that is conducted under the EPA Region 6 RAC II program. These reports address QA issues that are specific to the Task Order and facilitate timely communication of such issues. QA status reports address the following areas:

- Results of QA audits and other inspections, including quality improvement; opportunities that have been identified for further action
- Instrument, equipment, or procedural problems that affect QA
- Subcontractor performance issues
- Corrective actions
- Status of previously reported activities and quality improvement initiatives
- Work planned for the next reporting period.

At the program level, the EA QA Officer prepares quarterly status reports of QA issues that are related to EA's work on the EPA Region 6 RAC II program. These reports are distributed to EA's President, Corporate QA Officer, Program Manager, and, upon request, the EPA Region 6 Project Officer.

4. DATA VALIDATION AND USABILITY

This section describes the procedures that are planned to review, verify, and validate field and laboratory data. Procedures for verifying that the data are sufficient to meet DQOs and measurement quality objectives for the project are also discussed. Section 4.1 focuses on data review and reduction requirements for work conducted under the EPA Region 6 RAC II program. Section 4.2 addresses data validation and verification requirements. Section 4.3 addresses reconciliation with DQOs.

4.1 DATA REVIEW AND REDUCTION REQUIREMENTS

Data reduction and review are essential functions for preparing data that can be used effectively to support project decisions and achieve DQOs. These functions must be performed accurately and in accordance with EPA-approved procedures and protocol. Data reduction includes computations and data manipulations that produce the final results that are to support the investigation. Data review includes procedures that field or laboratory personnel conduct to ensure that measurement results are correct and acceptable in accordance with the QA objectives stated in this SAP. Field and laboratory measurement data reduction and review procedures and requirements are specified in previously discussed field and laboratory methods, SOPs, and guidance documents.

Field personnel will record, in a field logbook and/or on the appropriate field form (Appendix D), raw data from chemical and physical field measurements (EA SOP 016, Appendix G). The EA field staff has the primary responsibility for: (1) verifying that field measurements were made correctly; (2) confirming that sample collection and handling procedures specified in this project-specific SAP were followed; and (3) ensuring that field data reduction and review procedures and requirements are followed. The EA field staff is also responsible for assessing preliminary data quality and for advising the data user of potential QA/QC problems with field data. If field data are used in a project report, data reduction methods will be fully documented in the report.

The EPA Region 6 Laboratory, CLP laboratory, and/or subcontracted commercial laboratory will complete data reduction for chemical and physical laboratory measurements and will complete an in-house review of laboratory analytical results. The laboratory QA Manager will be responsible for ensuring that laboratory data reduction and review procedures follow the requirements that are stated in this SAP and in the laboratory QA manual. The laboratory QA Manager will also be responsible for assessing data quality and for advising the EA QA Officer of possible QA/QC problems with laboratory data.

4.2 VALIDATION AND VERIFICATION METHODS

Data that are used to support activities under the EPA Region 6 RAC II program must be valid for their intended purposes. This section outlines the basic data validation procedures that will be followed for field and laboratory measurements. The following sections identify personnel who are responsible for data validation and the general data validation process and EPA data validation guidance that will be followed.

4.2.1 Data Validation Responsibilities

When analytical services are provided by laboratories subcontracted by EA, EA is responsible for validation of the analytical data. The EA QA Officer has primary responsibility for coordinating EA's data validation activities. EA will conduct a level III validation on 100 percent of subcontracted laboratory data for investigation samples. Data validation conducted by EA will be detailed in the DESR.

Data validation and review will be completed by one or more experienced data reviewers. When data are generated by the EPA Region 6 Laboratory, it will be used as received from the laboratory, with no further validation. Data from CLP laboratories are validated by EPA's Environmental Services Assistance Team. Data validated by EPA will be summarized in a data validation report.

4.2.2 Data Validation Procedures

The validity of a data set is determined by comparing the data with a predetermined set of QC limits and criteria. EA data reviewers will conduct a systematic review of the data for compliance with established QC limits and data quality indicators (such as sensitivity, precision, and accuracy), on the basis of spike, duplicate, and blank sampling results that are provided by the laboratory. The data review will identify out-of-control data points, discrepancies in results, inaccuracies or omissions. EA data reviewers will evaluate laboratory data for compliance using the following criteria:

- Method and project-specific analytical service requests
- Sample extraction and analysis holding times
- Initial and continuing calibration acceptance criteria
- Field, trip, and method blank acceptance criteria
- Surrogate recovery
- Internal standard recovery
- Field duplicates, MS and MSD acceptance criteria
- MD and laboratory duplicate sample precision
- LCS accuracy

- Other laboratory QC criteria specified by the method or on the project-specific analytical service request form

- Compound identification and quantitation

- Overall assessment of data and completeness in accordance with project-specific objectives.

EA will follow the most current or applicable EPA CLP National Functional Guidelines (EPA 2014a, 2014b) and EPA CLP SOWs (EPA 2014d, 2015c, 2015d) for completing data validation for applicable test methods. Procedures in the CLP guidelines will be modified, as necessary, to fit the specific analytical method that is used to produce the data. In cases, data validation requirements will depend on: (1) DQO levels that are defined in Section 1.3; (2) reporting requirements that are defined in Section 1.4; and (3) data deliverables that are requested from the laboratory, as discussed in Section 1.6.

4.3 RECONCILIATION WITH DATA QUALITY OBJECTIVES

The main purpose of a QA system is to define a process for collecting data that are of known quality, are scientifically valid, are legally defensible, and fully support decisions that will be based on the data. To achieve this purpose, the SAP requires that DQOs be fully defined. Other parts of the QA system must then be planned and implemented in a manner that is consistent with the DQOs. QA system components that follow directly from the DQOs include: (1) documentation and reporting requirements; (2) sample process design and sampling methods requirements; (3) analytical methods and analytical service requests; (4) QC requirements; and (5) data reduction and validation and reporting methods.

After environmental data have been collected, reviewed, and validated, the data will undergo a final evaluation to determine whether the DQOs specified in this SAP have been met. EA will follow EPA's DQA process to verify that the type, quality, and quantity of data that are collected are appropriate for their intended use (EPA 2006c, 2006d).

The DQA process involves: (1) verifying that the data have met the assumptions under which the data collection design and DQOs were developed; (2) taking appropriate corrective action if the assumptions have not been met; and (3) evaluating the extent to which the data support the decision that must be made so that scientifically valid and meaningful conclusions can be drawn from the data. To the extent possible, EA will follow DQA methods and procedures that have been outlined by EPA (EPA 2006c, 2006d).

Following the conclusion of the RI field program and receipt of fixed-laboratory data, the data evaluation will include:

- Data usability evaluation and field QA/QC – The usability of the laboratory analytical data in terms of the CLP data validation summaries and field QA/QC will be evaluated.

- Data Reduction and Tabulation – Field sampling data and analytical results will be reduced and tabulated.

- Data Evaluation Summary Report – A DESR will be submitted that documents and summarizes the analytical data collected during this RI, including the data quality and usability as related to the site-specific DQOs. Field QA/QC results will be summarized in context with fixed-laboratory sample results.

The analytical and field data will be compiled into a format that is compatible with EPA Region 6 or National Electronic Data Management Network. EA will use the data to prepare the RI Report, including the SLERA and HHRA Reports. The data will ultimately also be used to support the FS and ROD for the site.

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Tables

Figures

Appendix A

Conceptual Site Model Technical Memorandum

Appendix B

Screening Criteria and CLP/Private Laboratory Reference Limits

Appendix C

Analytical Method Reference Sheets and Contract Required Quantitation Limits

Appendix D

Field Forms

Appendix E
Sanborn Maps and Historical Aerial Photographs

Appendix F

Vapor Intrusion Sampling Procedures

Appendix G

Standard Operating Procedures